

Water and Wastewater Technologies Export Market Plan

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Abbreviations and Acronyms

ADB	Asian Development Bank	IMF	International Monetary Fund
AfDB	African Development Bank	IRBI	Industrial Reconstruction Bank of India
APAZU	National Program for Potable Water and Sewerage in Urban Zones	JETRO	Japan External Trade Organization
ASEAN	Association of Southeast Asian Nations	KOWACO	Korea Water Resources Corporation
BECC	Border Environment Cooperation Commission	LIFE	Lemna Infrastructure Financing Enterprise
BOT	Build-operate-transfer	MHUNC	Ministry of Housing Utilities and New Communities (Egypt)
BOO	Build-own-operate	MIGA	Multilateral Investment Guarantee Agency
B2B	business-to-business	MPWWR	Ministry of Public Works and Water Resources (Egypt)
B2C	business-to-consumer	m ³	cubic meters
CNA	National Water Commission	n.a.	not available
DACON	Data on Consulting Firms	NGO	non-governmental organization
DCA	Development Credit Authority	NADBank	North American Development Bank
EBI	Environmental Business International	NAFTA	North American Free Trade Agreement
EBRD	European Bank for Reconstruction and Development	OECD	Organization for Economic Cooperation and Development
EEAA	Egyptian Environmental Affairs Agency	OPIC	Overseas Private Investment Corporation
EPA	Environmental Protection Agency	PEFCO	Private Export Funding Corporation
EU	European Union	PVC	polyvinyl chloride
Ex-Im Bank	Export-Import Bank of the United States	RMB	yuan renminbi (Chinese currency)
GEF	Global Environment Facility	SBA	U.S. Small Business Administration
GEEMF I and II	Global Environment Emerging Markets Funds	SWCC	Saline Water Conversion Corporation
HS	Harmonized Commodity Description and Coding System	TDA	U.S. Trade and Development Agency
HTS	Harmonized Tariff Schedule	TIFA	Trade and Investment Framework Agreement
IBRD	International Bank for Reconstruction and Development	UNDP	United Nations Development Program
IDA	International Development Agency	US-AEP	U.S.-Asia Environmental Partnership
IDB	Inter-American Development Bank	USAID	U.S. Agency for International Development
IDBI	Industrial Development Bank of India	UV	ultraviolet
IFC	International Finance Corporation	WB	World Bank
IFCI	Industrial Finance Corporation of India	WTO	World Trade Organization

Note: Unless otherwise noted, dollar figures given are U.S. dollars.

Executive Summary

This report is designed to serve as a guide for U.S. exporters of water and wastewater technologies and services and focuses on two segments of the water market:

- 1. Water equipment and chemicals:** equipment, supplies, and maintenance for the delivery and treatment of water and wastewater.
- 2. Engineering and construction services:** engineering, construction, design, management, operation and maintenance, etc.

Over 300 private U.S. companies export filters, pumps, valves, pipes, instruments, and other equipment, as well as chemical and biological products for water and wastewater treatment. There are several hundred water engineering and consulting firms in the United States, many of which offer their services internationally. By concentrating on the market segments where U.S. industry is most competitive, this report aims to engage more water and wastewater technology firms in exporting their products overseas.

The Market

The global water market has been growing rapidly over the last decade and constitutes well over a third of the global environmental market. Market pricing, combined with the growing privatization of water and wastewater utilities, generates private capital to create and maintain rational water markets. The market is enhanced by more consistent enforcement of environmental regulations, worldwide consolidation of the water industry, and the proliferation of e-business. The global market for water and wastewater equipment and chemicals was about \$42 billion in 1998. The market is expected to grow at a 4 percent rate over the next two years and reach almost \$47.3 billion by 2002.

The United States, Western Europe, and Japan represent over 80 percent of the total market size, but those are mature markets with an average growth of 3-4 percent. The economic recovery of emerging markets in

Southeast Asia and Latin America from the 1997 crisis, rapid expansion of the Chinese economy, and increasing demand in the Middle East promise a return to the 10 to 20 percent pre-1997 market growth in the developing world.

The major players in the global water and wastewater industry come from the United States, France, Britain, Japan, and Germany. Integrated, global companies based in France (Vivendi, Lyonnaise des Eaux) generally have a competitive edge over U.S. firms, which are mostly smaller and more specialized. European water companies that have more experience in operating and serving privatized or partially privatized facilities have a competitive edge in emerging markets where water and wastewater sectors are undergoing privatization.

U.S. companies are major exporters of water and wastewater equipment and chemicals. Many U.S. firms produce specialty equipment that is not available from other suppliers, which gives them a competitive edge in certain niche markets. U.S. companies frequently find industrial wastewater projects and projects funded by U.S. development agencies.

In the area of water and wastewater treatment works, the market is dominated by French and British companies. In particular, companies from France and the United Kingdom are by far the most competitive in providing integrated packages of designing, building, managing, and even owning water infrastructures around the world.

Strategies to Improve U.S. Industry Competitiveness

In order to succeed in the international market for water and wastewater technologies and services, U.S. firms should be aware of the realities of doing business overseas, know and be able to take advantage of particular market characteristics, and use available information support services.

According to environmental exporters, key success factors in overseas markets include:

Table 1. Water and Wastewater Markets of 12 “Best Prospect” Countries

<i>Country</i>	<i>Total Market Size (millions of dollars)</i>	<i>Annual Growth (percent)</i>	<i>Share of Imports (percent)</i>	<i>U.S. Import Market Share (percent)</i>
Australia	603 (1999)	7	70	55
Brazil	1,700 (1998)	10	20	35
China (including Hong Kong)	5,336 (1999)	25–35	35	12
Egypt	856 (1998)	10	90	35
India	1,180 (2000)	15	40	25
Japan	6,000 (1996)	5–8	n.a.	n.a.
South Korea	3,400 (2000)	13	40	20
Mexico	2,390 (2000)	10	80	70
Saudi Arabia*	357 (1998)	5	85	16
Spain	4,000 (1998)	n.a.	n.a.	n.a.
Taiwan	1,900 (1999)	9	75	28
United Kingdom	4,000 (2000)	4	55	25

* The data for Saudi Arabia only address the desalination market.

n.a. = not available

See Chapter 4, “Best Prospects in Water and Wastewater Treatment,” for additional information on these countries and data sources.

- **Understanding local markets.** The first step in a successful export market strategy is knowing where the markets are and how to access them. Knowing the stage and pace of market development, host government regulations, and the local business culture is critical in prioritizing business development efforts.
- **Building alliances and working effectively with partners in export countries.** Local partnerships and representation are desirable for U.S. companies so that they can learn about attractive market opportunities before the competitors. Methods for developing a local presence range from hiring a local consultant or agent to represent the firm, to establishing a local office or a joint venture. Engaging in joint exporting activities (through joint ventures and consortia) with other U.S. firms is another way to enter a new market.
- **Finding financing for export activities.** Development assistance is a primary driver in the water and wastewater sectors of emerging market countries. Multilateral development agencies strongly support, through technical and financial assistance, water supply infrastructure, wastewater treatment systems, and watershed clean-up projects, representing significant market opportunities. U.S. technology and services companies also can take advantage of many U.S. investment and export credit programs. Commercial financing sources include private investment funds, U.S. and local commercial banks, and vendor financing.

Best Prospect Countries

The countries that represent best prospects for U.S. exporters of water and wastewater equipment and services are determined by a number of factors, including:

- The overall size of the water and wastewater market in the country;
- The openness of that market to imports (partly reflected in the share of imports in the total market);
- The market’s growth rate; and
- The historic U.S. position in the market and the U.S. import market share.

This report contains market profiles of 12 countries that fit several of these criteria: Australia, Brazil, China, Egypt, India, Japan, South Korea, Mexico, Saudi Arabia, Spain, Taiwan, and the United Kingdom, representing a mix of developed and developing countries. Table 1 presents a summary of the estimates of the principal market indicators for the profiled countries.

Brazil, China, India, Japan, South Korea, Mexico, Spain, Taiwan, and the United Kingdom all have water and wastewater markets that exceed \$1 billion in size. Such emerging markets as China, India, South Korea, Taiwan, Mexico, and Brazil have enormous potential due to the extent of unmet water supply and sewerage needs. Their growth rate usually exceeds 10 percent per year. Japan, the United Kingdom, Spain, and Australia are

mature markets with slower growth, but their sheer size and favorable business climate make them worth exporters' consideration. The two Middle Eastern countries described in this report (Egypt and Saudi Arabia) are niche markets for U.S. exporters. Egypt is a large, exclusively

aid-driven market, where massive U.S. foreign aid gives a significant advantage to American companies. Saudi Arabia is a highly specialized market with a focus on desalination technology, where the United States also has a good strategic position.

Chapter 1

Overview of the Global Market for Water and Wastewater Technologies

Access to safe drinking water and contamination of surface water bodies is a major problem in many areas of the globe. In the year 2000, approximately 1.1 billion people (18 percent of the world's population) lacked access to safe drinking water, and 2.4 billion (40 percent of the total population) lacked adequate sanitation.¹ Most of these people live in developing countries, predominantly in rural areas. Over one-third of the urban water supplies in developing countries operate only intermittently, while roughly 40 percent of the drinking water supply is lost due to leakage in the distribution systems.

At the same time, countries have come to recognize that an adequate supply of clean water and effective wastewater treatment is essential for sustainable development. Governments and organizations around the world are investing substantial sums in water and wastewater improvements. These expenditures create real opportunities for U.S. companies to export water and wastewater equipment technology.

In many parts of the world, wastewater receives no treatment before being discharged into water bodies. The resulting pollution of the receiving waters threatens the human and animal populations that rely on these streams, lakes, and rivers as a source of drinking water or habitat.

Today, it is estimated that only 66 percent of wastewater is treated in Europe, 35 percent in Asia, 14 percent in Latin America, and almost none in Africa.² Many important water bodies throughout the world are in violation of local water quality standards. More than 35 percent of drinking water supplies in Africa are contaminated in violation of national health standards, 21 percent in Asia, and 18 percent in Latin America and the Caribbean.

The principal constraints to the development of the water supply and sanitation sector are funding limitations, inadequate cost recovery, and inadequate operation and maintenance. As water sources become contaminated,

1. *Global Water Supply and Sanitation Assessment: 2000 Report*, World Health Organization, 2000.

2. Ibid.

Figure 1.1. Global Facts about Water Supply and Wastewater Treatment, 2000

Worldwide:

- 18% of the world's population lacks access to safe drinking water.
- 40% of the world's population lacks adequate sanitation.



In Latin America:

- 14% of wastewater is treated.
- 18% of drinking water supplies in Latin America and the Caribbean violate national health standards.

In Asia:

- Only 35% of wastewater is treated.
- 21% of drinking supplies are in violation of national health standards.

In Africa:

- Almost no wastewater is treated.
- Over 35% of drinking supplies violate health standards.

Source: World Health Organization, *Global Water Supply and Sanitation Assessment: 2000 Report* (Geneva: World Health Organization, 2000).

increasingly effective and costly treatment methods are required. The lack of access to water for drinking and industrial uses, as well as to wastewater treatment, is thus a major limitation to sustainable development.

The incentives for improving water and wastewater infrastructure in developed countries are primarily regulatory, particularly in Western Europe, where countries are struggling to comply with the European Union's increasingly stringent regulations for drinking water quality and wastewater treatment standards. In developing countries, the driver is public health: 2.2 million people, most of them children, die there every year from diseases associated with the lack of safe drinking water, inadequate sanitation, or poor hygiene.³

As a result, the global water market has been growing rapidly over the last decade and constitutes well over a third of the global environmental market. This report is designed to serve as a guide for U.S. exporters of water and wastewater technologies and services and focuses on two segments of the water market:

1. Water Equipment and Chemicals: Equipment, supplies, and maintenance for the delivery and treatment of water and wastewater. About 2,800

private U.S. companies supply filters, pumps, valves, pipes, instruments, and other equipment, as well as chemical and biological products. However, only 800 of them can be regarded as potential exporters, while almost 300 are actually exporting their products.⁴

2. Consulting and Engineering Services: Engineering, consulting, design, management, operation, and maintenance, etc. There are several hundred water engineering and consulting firms in the United States, many of which offer their services internationally.

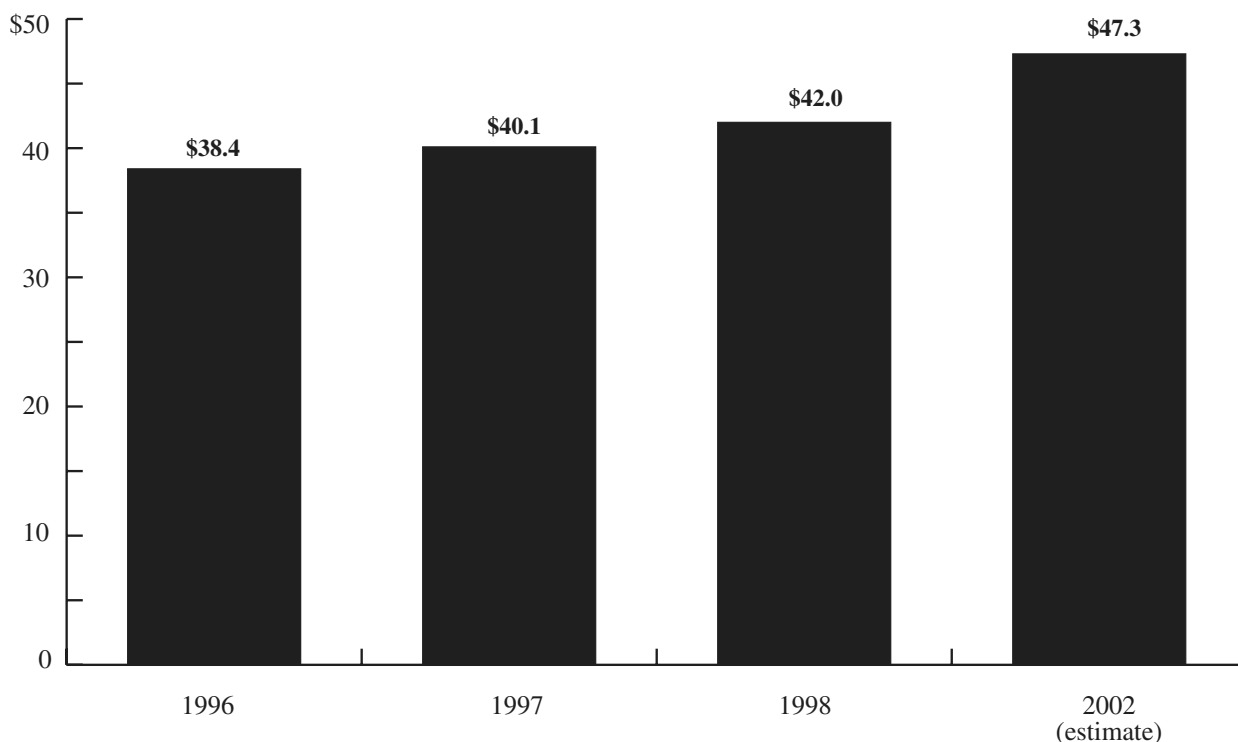
This report does not address two other segments of the water market—water utilities and wastewater treatment works—for two reasons. First, municipal water and wastewater utilities account for 81 percent and 95 percent of their respective market segments in the United States and are not involved in any exporting activities. The remaining newly privatized utilities are mostly owned by large French and British water companies.⁵ Second, U.S. private utility companies cannot compete for water utility markets overseas. The poor performance

3. Ibid.

4. "The U.S. Water Industry," *Environmental Business Journal*, Vol. XII, No. 7/8, 1999.

5. Ibid.

Figure 1.2. Global Market Size: Water and Wastewater Equipment and Chemicals, 1996–2002 (billions of dollars)



Source: "Global Environmental Markets 2000," *Environmental Business Journal*, Vol. 12, No. 9/10 (Sept./Oct. 2000).

of Azurix in a water and wastewater concession in Buenos Aires, Argentina is a recent example of this phenomenon.

By concentrating on the market segments where U.S. industry is most competitive, this report aims to engage more water and wastewater technology firms in exporting their products overseas.

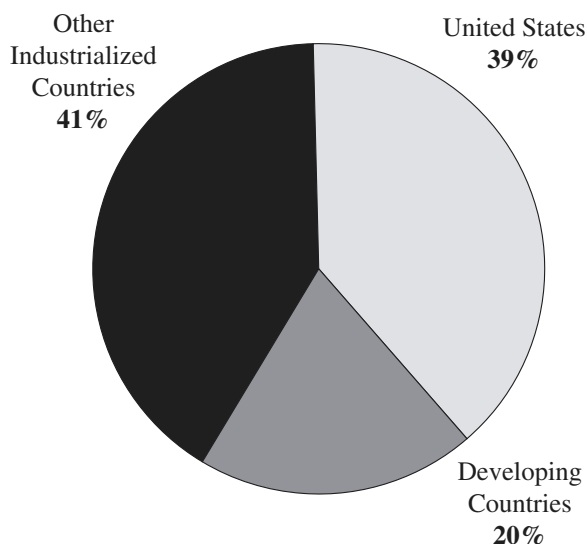
Market Size and Characteristics

According to Environmental Business International,⁶ the global market for water and wastewater equipment and chemicals was about \$42 billion in 1998, which represents a 5 percent growth over the 1996 figure. The market is expected to grow at a 4 percent rate over the next two years and reach almost \$47.3 billion by 2002. Water-related services also represent a significant share of the \$27.2 billion (1998) consulting and engineering market.

The United States, Western Europe, and Japan represent over 80 percent of the total market size, but those are mature markets with an average growth of 3 to 4 percent. At the same time, the economic recovery of emerging markets in Southeast Asia and Latin America from the 1997 crisis, rapid expansion of the Chinese economy, and broadening demand in the Middle East promise a return to the 10 to 20 percent pre-1997 market growth in the developing world.

6. "Global Environmental Markets 2000," *Environmental Business Journal*, Vol. XII, No. 9/10, 2000.

Figure 1.3. Share of the Global Market for Water and Wastewater Equipment, 1998



Source: World Health Organization, *Global Water Supply and Sanitation Assessment: 2000 Report* (Geneva: World Health Organization, 2000).

With assistance from international donors, public sector agencies in developing countries, particularly in Asia, have launched multi-million-dollar spending programs in water supply and sanitation, and are encouraging private sector investments. The proportion of industrialized countries' development assistance devoted to water supply and sanitation increased steadily from 1986 to 1996, rising from 3.4 percent to 6.6 percent of total assistance. In terms of cash, bilateral commitments from industrialized countries for assistance to developing countries in this sector rose from \$1 billion in 1986 to \$2.9 billion in 1996 (these numbers do not include France). In absolute terms, Germany's and Japan's donor funding was particularly large: Germany spent nearly \$3.4 billion, while Japan invested \$9.5 billion.⁷

The Market in Industrialized Countries

The water and wastewater equipment markets in industrialized countries, including the United States, comprise roughly 80 percent of the global market, or approximately \$34 billion a year. The U.S. market for water and wastewater equipment accounts for about half of this amount (\$16.6 billion in 1999).⁸ However, these markets are growing slowly, and the demand is mostly satisfied by existing suppliers. (See Chapter 4 for detailed country profiles.)

In Japan, opportunities exist mainly in wastewater treatment (this market segment exceeds \$6 billion annually⁹), due to water pollution control regulations, which were tightened in 1996–1997. This regulatory pressure has raised demand for both upgrading municipal sewage treatment facilities and industrial effluent treatment equipment (particularly for toxic chemicals). A need also exists for "closed" systems for recycling industrial wastewater.

Canada's market is well penetrated by U.S. water and wastewater equipment suppliers. Despite very slow market growth, some opportunities still exist in municipal wastewater treatment. Many Canadian municipalities have aging sewerage infrastructure and even discharge untreated sewage into the waterways.

The EU market for water and wastewater treatment equipment is driven primarily by the need to comply with the EU Urban Wastewater Treatment Directive. In addition, large multinational food and beverage, and chemical companies are installing effluent treatment works at

7. *Global Water Supply and Sanitation Assessment: 2000 Report*, World Health Organization, 2000.

8. "The U.S. Water Industry," *Environmental Business Journal*, Vol. XII, No. 7/8, 1999.

9. *Environmental Market in Japan*, U.S. Department of Commerce, International Trade Administration, 1998.

many of their European sites in response to local environmental regulations and the desire to enhance their public image.

The biggest market opportunities in the European Union are for biological treatment equipment for both aerobic and anaerobic treatment systems. There is also significant demand for separation equipment for new municipal wastewater treatment plants. The market for high purification (filtration, membrane) systems for industrial and other commercial applications is also expected to grow quickly in Western Europe: from about \$300 million in 1999 to over \$400 million in 2006.¹⁰ Overall, the market for newer, advanced technologies is expanding at the expense of traditional equipment.

In France, where 9 percent of the population (mostly in rural areas) still does not have access to centralized wastewater treatment systems, wastewater treatment technologies represent the largest segment of the water market. In order to comply with EU regulations, all French towns must install secondary treatment by 2006. In environmentally sensitive areas, tertiary treatment is required in all communities with at least 10,000 residents. However, opportunities for U.S. firms are very limited in France: Vivendi (formerly Compagnie Générale des Eaux) and ONDEO (formerly Suez Lyonnaise des Eaux) dominate the French market, while their closest competitors hardly reach a 1 percent market share.

The British market for water and wastewater equipment is among the largest and fastest growing in Europe, and is relatively open to foreign players. Recently privatized water utilities and major industrial users (for example, power and chemical companies) account for more than 60 percent of the market.

A major market opportunity in Germany is the rehabilitation and upgrading of the water and wastewater infrastructure. The cost of constructing new sewerage systems in the New Lands (formerly East Germany) is about \$50 billion, plus another \$15 billion for water and wastewater system modernization projects in the New Lands and \$13 billion in the Old Lands.¹¹

Countries in southern Europe (Italy, Spain, Portugal, and Greece) represent even greater opportunities, although mostly for EU companies. In Italy, over 60 percent of the population does not have access to adequate sewage treatment, and 30 percent of the wastewater is discharged untreated. An overall investment of about \$62 billion over the next ten years will be needed to bring Italy's water and wastewater infrastructure up to EU standards.¹² Spain has a similar situation, with 78 percent of

the major cities not meeting the European Union's water pollution control directives, and just over 40 percent of the population having access to adequate drinking water treatment systems. Over the next five years, Spanish public and private companies will invest about \$30 billion in water purification equipment and sewage treatment systems.¹³

The Organization for Economic Cooperation and Development (OECD) countries of Central Europe (Poland, Hungary, and the Czech Republic) and other Central and East European nations are also making efforts to improve their environmental performance in view of their planned accession to the European Union. The market is stimulated by the implementation of the European Union's drinking water quality and wastewater management standards but is also restricted by limited availability of funds and administrative failings. As the Central European markets are being restructured to involve more private participation, the main opportunities are in industrial wastewater treatment, as well as rehabilitation of the antiquated water supply and municipal wastewater treatment systems. Optimistic assessments valued this market at as high as \$4 billion in 1999, with substantial short-term growth prospects, particularly due to the large lending program of the European Investment Bank.¹⁴ For example, Hungary's water and wastewater market is currently estimated at \$200–250 million a year and is growing by 5 to 8 percent annually.¹⁵ However, Central and East European water markets are likely to be dominated by EU firms.

The Market in Developing Countries

Many developing countries are unable to meet their population's need for safe drinking water and adequate sanitation. As the populations and economies of these countries grow, so does the demand for water. The development of environmental regulations also contributes to the need for water and wastewater technology and monitoring. This section discusses the current conditions in developing regions of the world.

Table 1.1 shows average annual investments in water supply and municipal wastewater treatment in Africa, Asia, and Latin America and the Caribbean from 1990 to 2000. The table demonstrates that investments in water supply are significantly higher than those in sanitation, which contributes to the large deficit of adequate

10. *European Commercial Scale Water Treatment Equipment Markets*, Frost and Sullivan, no. 3822-15, 2000.

11. Ibid.

12. Ibid.

13. Ibid.

14. *Central and Eastern European Water and Wastewater Treatment Equipment Markets*, issued by Frost and Sullivan, no. 3792-15, 2000.

15. *Hungary: Water Treatment Equipment and Services, Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 2001.

Table 1.1. Average Annual Investments in Water Supply and Sanitation in Developing Countries, 1990–2000 (billions of U.S. dollars)

	<i>Africa</i>	<i>Asia</i>	<i>Latin America</i>	<i>Total</i>
Water Supply	4.09	6.06	2.41	12.56
National Investment	1.21	3.82	1.86	6.89
External Support	2.88	2.24	0.55	5.67
Sanitation	0.54	1.10	1.50	3.14
National Investment	0.26	0.95	1.11	2.32
External Support	0.28	0.15	0.39	0.82
Total	4.63	7.16	3.91	15.70

Source: World Health Organization, 2000.

sanitation access in the developing world. It also shows that most of the investments come from domestic sources rather than international donors.

Asia. Despite the financial crisis in 1997 and 1998, the Asian water market is stronger than ever. In fact, the economic turmoil made some Asian governments seek to increase the efficiency of the water and sewage infrastructure by attracting private capital. The potential demand is enormous: 80 percent of the global population without access to improved sanitation and almost two-thirds without access to improved water supply live in Asia. However, most of this demand is concentrated in the markets that are in the early stages of development: Southeast Asia, China, and India. Many of these countries have recently promulgated new environmental regulations that are likely to give a boost to the industrial wastewater treatment market as well. Particularly large investments are made in water supply, a significant share of which comes from bilateral and multilateral lending sources. The market in China alone exceeds \$1 billion per year, with annual growth approaching 15 percent.

In more developed Asian economies, the market is either saturated (as in Japan) or growing very slowly (for example, in South Korea, Taiwan, and Singapore). At the same time, these more mature markets offer opportunities for sophisticated water and wastewater treatment technologies produced in the United States.

Middle East/North Africa. Water is not only an environmental issue, it's also a critical economic and political issue in the Middle East. Middle Eastern countries struggle to alleviate water shortages for drinking and irrigation through desalination and wastewater reuse. Water supply and wastewater treatment systems, especially in rural areas, require upgrading and expansion. The desalination technologies market is projected to grow par-

ticularly fast, from about \$1 billion in 1999 to \$2.5 billion in 2006.¹⁶

While oil-rich countries of the region (Saudi Arabia and the small states of the Persian Gulf) are able to fund these projects themselves, others (Egypt, Jordan) rely heavily on foreign donor assistance. Opportunities for U.S. firms exist mainly in countries that have good political relations with the United States: Saudi Arabia, Egypt, and Jordan. Egypt is the largest recipient of U.S. bilateral assistance in the world, with the U.S. Agency for International Development (USAID) having spent billions of dollars on this country's water and wastewater infrastructure. (See Chapter 4 for more country-specific details.)

Latin America. Latin America presents abundant market opportunities in water and wastewater treatment—both in contract operations of utilities (most of which are being privatized), as well as subsequent technology investments. Although drinking water coverage is relatively high in Latin America (85 percent), growing urban populations and obsolete, inefficient infrastructure create a demand for investments in water supply. Most drinking water projects are publicly financed, with additional monies coming from the World Bank, the Inter-American Development Bank (IDB), and, increasingly, Japanese bilateral funding. At the same time, water utility privatization has been a major market driver in Chile, Argentina, Mexico, Colombia, and, most recently, Brazil. In municipal wastewater treatment, private sector participation has not yet materialized in most Latin American countries (except Argentina and Chile), with most funds coming from multilateral and bilateral lenders.

According to Environmental Business International, opportunities focus on about 550 municipal projects across the continent, amounting to over \$40 billion of investment.¹⁷ Opportunities in industrial wastewater treatment are much fewer, since governments in Latin America are unwilling or unable to enforce environmental regulations on industrial producers.

Africa. Africa has the lowest water supply coverage of any region, with only 62 percent of the population having access to improved water supply (the situation is much worse in rural areas). Sanitation coverage in Africa is also poor (60 percent), with only Asia having lower coverage levels. Almost all African countries depend entirely on donor assistance to help them solve these problems. Most of this aid comes from multilateral lenders and donors

16. *Middle Eastern, North African, and European Desalination Plant Markets*, Frost and Sullivan, no. 3857-15, 2000.

17. "Global Environmental Markets 2000," *Environmental Business Journal*, vol. XII, no. 9/10, 2000

(the World Bank, the African Development Bank, and the United Nations Development Program), as well as French and British bilateral development agencies (for their former colonies). The traditional domination of French and British companies, in addition to the generally unfavorable business climate, have deterred U.S. companies from exploring water-related opportunities in Sub-Saharan Africa.

The Republic of South Africa is the biggest water market in Sub-Saharan Africa. The greatest market potential lies in the efforts to provide potable water and sanitation in rural and poorer urban areas that still have no access to these services. The annual market for water and wastewater equipment was about \$100 million in 1996, and has been growing at 12 to 15 percent per year.¹⁸

Newly Independent States. The states of the former Soviet Union offer potentially enormous opportunities in the water sector, particularly in municipal and industrial wastewater treatment. However, local funding resources are extremely limited, and the uncertainties of the business climate hamper market expansion beyond donor-funded projects. Large water and wastewater infrastructure projects funded by multilateral development banks in Russia, Ukraine, the Caucasus states, and Central Asia are essentially the only source of water and wastewater equipment supply opportunities in this region.

Trends Affecting the Water and Wastewater Industry

The global water industry has entered a period of revolutionary changes. Water prices are being adjusted to reflect quality, quantity, and specific end-use values. Market pricing, combined with the growing privatization of water and wastewater utilities, generates private capital to create and maintain rational water markets. The market is further enhanced by the more consistent enforcement of environmental regulations, worldwide consolidation of the water industry, and proliferation of e-business.

Privatization

An important trend in recent years has been the move toward privatization of water and wastewater infrastructure throughout the world. Governments, even in developed countries, are faced with the stark reality of aging and inadequate infrastructure, unable to effectively de-

liver services to their rapidly growing populations. The economic reality associated with these problems is overwhelming and leads governments to turn to the private sector for assistance.

Among OECD countries, the United Kingdom represents the most vivid example, with completely privatized water and wastewater operations in England and Wales. In developing countries, Latin America and East Asia have been on the forefront of the water utility privatization trend. The increased role of the private sector leads to greater levels of investment in infrastructure and service improvements, thereby offering enhanced opportunities for water and wastewater equipment suppliers.

Compared to other infrastructure sectors such as telecommunications, power, and transportation, the water sector is viewed as more difficult to privatize because water supply and sanitation are considered by many to be social services. Additionally, because regulatory and pricing mechanisms for water and wastewater are less well-established than for other infrastructure industries, many investors view the water sector as having relatively higher risks and lower profit margins than other infrastructure sectors.

Perhaps because consumers willingly pay for water, but are more reluctant to pay for the indirect benefits of sewage treatment, private participation in developing countries has been far more common in water than in wastewater. In Latin America, however, increasing wealth has led to an extension of concessions to the sewerage subsector.

Several public-private mechanisms have evolved to provide water and wastewater services. These are: (1) management contract, (2) lease, (3) concession, (4) build-operate-transfer (BOT) and build-own-operate (BOO) schemes, and (5) asset sale. Under contract operations, a company is hired to operate and maintain the entire utility or a portion of the utility functions for a specified term; the company does not finance or develop new facilities. Under a lease arrangement, the private contractor typically finances working capital for smaller equipment and infrastructure, along with operating, maintaining, and managing the utility facilities. A concession typically includes the financing of most infrastructure and the concessionaire receives the system revenues as compensation. BOT and BOO schemes are typically concessions that include the private development of new water or wastewater facilities. Asset sales, or sale of shares, formally transfer the utility into the private sector. Table 1.2 illustrates the different privatization scenarios and the roles of the public and private sectors under each arrangement.

About 50 percent of the contracts awarded in the last decade have been concession contracts. Countries seem

18. *South Africa: Water Treatment Services*, Industry Sector Analysis, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

Table 1.2. Types of Privatization Arrangements in the Water Industry

	<i>Management Contracts</i>	<i>Lease Contracts</i>	<i>BOT or BOO</i>	<i>Full Concession</i>	<i>Asset Sale</i>
Ownership	public	public	public	public	private
Investment	public	public	private	private	private
Operation	private	private	private	private	private
Tariff Collection	public/private	public/private	public	private	private

Source: Silva et al., "Private Participation in the Water and Sewerage Sector—Recent Trends," *Public Policy for the Private Sector*, The World Bank Group, 1998.

to favor concessions over other forms of private involvement because such arrangements allow them to take advantage of the efficiencies offered by private operators while maintaining control over the assets. Outright divestiture of water and wastewater assets is relatively rare.¹⁹

Although the numbers of international companies investing in water and wastewater projects in developing countries is growing, to date only a handful of companies have sponsored most of the projects. French water companies ONDEO, Vivendi, and SAUR International, along with Spain's Aguas de Barcelona and the British firm Thames Water, accounted for 58 of the 79 projects tracked by the PPI Database from 1990 to 1997.²⁰ Only Vivendi and ONDEO operate in every region of the world. These international companies often team up with local companies, many of which were never involved in the water and wastewater business before, to form consortia for bidding on concessions.

Consolidation and Globalization

The shape of the global water and wastewater industry has changed considerably in the last decade. Widespread consolidation among manufacturing and service companies, as well as utilities, has led to the emergence of giants in the industry. Consolidation in the name of efficiency and globalization has brought together utilities and manufacturers across the globe. These newly consolidated companies have the ability to provide full-package solutions to their customers.

The globalization and consolidation trends dominating water markets around the world have had a major impact on the U.S. water industry in recent years. French firm Vivendi's purchase of U.S. Filter for \$6.2 billion in 1998 has created a company (whose \$3.1 billion U.S. arm is now called Vivendi Water) with global revenues of

about \$20 billion in equipment and chemicals, utilities, concessions, and services. Vivendi Water now incorporates over 100 companies previously acquired by U.S. Filter. In 1999, the French firm ONDEO acquired Nalco Chemical and United Water Resources to increase its worldwide water and wastewater revenues to \$6.3 billion. These acquisitions have further shrunk the U.S. industry's global market share, but also opened more markets for companies with a large base of U.S. employment, if not ownership.

In another key development, Azurix Corporation, after becoming a publicly traded company in 1999, acquired Britain's Wessex Water (water technology, engineering, and services) and Germany's Lurgi Bamag GmbH (water process engineering), making it the largest American firm in the international water market. However, Azurix has recently failed financially in its large water concession in Argentina, and has not been performing well in its other engagements in developing countries. As a result, Azurix was re-acquired by its former parent company, Enron Corporation, in March 2001.

U.S. water treatment equipment manufacturing companies are also consolidating. With Vivendi Water almost beyond reach of its U.S. competitors, Ionics (\$351 million) is firmly in second place, followed by Osmonics (\$177 million), which doubled in size between 1993 and 1998, and Waterlink (\$135 million), which grew 440 percent between 1995 and 1998. Consolidation is also evident in the water chemicals market, with Hercules, Inc., becoming the world's largest supplier of specialty chemicals for water treatment programs through a number of acquisitions. At the same time, there is practically no short-term growth envisioned in the U.S. water equipment and chemicals manufacturing markets outside Vivendi Water. This demonstrates that equipment-only suppliers are bound to lose market share to integrated equipment and services providers.

With the growing privatization of utilities, the line separating water and wastewater utilities from companies selling products and services is increasingly blurred. Large companies such as Vivendi that own and run utility operations are also producing the equipment used as

19. Silva, et al., "Private Participation in the Water and Sewerage Sector—Recent Trends," *Public Policy for the Private Sector*, The World Bank Group, 1998.

20. "Private Sector Note No. 196," *PPI Project Database*, The World Bank Group, 1999.

part of the investment, thus putting the end-user and the supplier under the same roof. A former U.S. Filter executive noted: “Virtually none of Vivendi’s business was equipment sales and virtually all of ours was, now we have their operations and services to offer and they have our equipment and technology.”²¹ Large companies also have the added benefit of increased financial resources and stability to enable them to provide financing assistance to their customers. As a result of economies of scale and a market that is difficult to break into, smaller water and wastewater companies are left at a disadvantage in the global market when competing against these large corporations.

The globalization in the water and wastewater industry has progressed to such an extent that it is now difficult to define what constitutes an American company. For example, successful water and wastewater delivery companies, i.e., those producing pipes, pumps, and filters, build manufacturing plants abroad. Identifying whether a pipe made abroad for an American-owned company should be considered an American export is not a simple matter. As a result, it is particularly difficult to identify the competitive advantage of American water and wastewater companies. In many ways, geographic ties are no longer relevant in a world of multinational partnerships.

Market Pricing

Global population growth and urbanization, along with regional water shortages, are increasing the demand for clean water at an unprecedented rate. These factors, along with accelerating privatization of water and wastewater utilities, has led to the growing recognition that water is an economic good, and that in order to deliver reliable, adequate services to a wide range and growing number of customers, full-cost pricing mechanisms need to be implemented.

For years, public utilities have relied on subsidies in addition to user fees to cover the costs of water supply, particularly in rural, agricultural, and low-income areas. Governments are starting to realize that the use of subsidies results in overall inefficiencies and lack of resources for improvements. This realization has started the trend toward the use of full-cost pricing, where the total cost of service delivery is passed on to the consumer, thereby promoting water conservation and increasing the financial and physical health of the utility.

With growing privatization of utilities, market pricing models that capture the cost of service delivery will

continue to expand. Privatized utilities must be able to provide a service and remain financially sound. Some critics contend that full-cost pricing of water will put basic water services beyond the reach of many poorer users, and that providers of basic services should not profit from user fees. This has made privatization of water services and full-cost pricing controversial. In the long run, utilities that are able to fully capture the costs associated with the provision of their services are better able to maintain their facilities, invest in and maintain equipment, and service their customers.

Financing Sources

Financing is critical to the success of water and wastewater projects in emerging markets. Governments faced with the challenge of meeting the demand for water and sewerage infrastructure growth and improvement are increasingly turning to private sources to finance these capital-intensive projects. New players include commercial banks and funds, as well as large water and wastewater firms themselves. One new trend in water and wastewater financing is the stock market. More and more companies have gone public, relinquishing private ownership to investors in exchange for needed capital for project financing.

Many utilities also are requesting extended payment terms as a precondition to placing an order for new technology and equipment. At present, few companies can afford to take on their customer’s credit risk by providing sufficient funding for extended payment plans, but leading industry experts contend that exporting companies must be able to provide extended payment terms to initially win orders and build long-term relationships with the clients.

Finding a financing source is no less important than ensuring project *financeability*. Project financeability means the lender gets its money back—with a profit and within a reasonable timeframe—and requires the existence of a cost-recovery mechanism. If a country does not have the political will to impose and collect reasonable user fees, the project is unlikely to attract private capital sources.

Regulatory Development

National governments worldwide are increasing the stringency of both ambient and drinking water quality standards to combat the deterioration of their water resources and halt the spread of pollution. Among developed countries, this trend is particularly visible in the European Union, where EU directives compel member countries (and stimulate accession candidates) to com-

21. “Vivendi Acquisition of U.S. Filter Fuels Global Growth to \$13 Billion in Water,” *Environmental Business Journal*, vol. XII, no. 7/8, 1999.

ply with new, tougher regulations. With increasing pressure from international donors and neighboring countries, these trends are spreading to the developing world.

In the developing world, while environmental regulations have been established, little has been done until recently to ensure enforcement. The recent trend in many developing countries, particularly in Southeast Asia, is toward increased monitoring of regulatory compliance and tougher sanctions for violations. With increased enforcement, monetary penalties, and corrective action requirements, industries are starting to internalize the costs of environmental compliance by investing in cleaner process technology and end-of-pipe treatment equipment. The impact on the market is a greater level of demand for industrial wastewater treatment equipment.

Another trend in regulatory development is the integration of economic incentives into traditional command-and-control regulations. The command-and-control system is often seen as too confrontational in many developing countries. It also tends to emphasize end-of-pipe pollution control technologies. Economic instruments (such as effluent charges and user fees) give industry the flexibility to comply with environmental requirements. The system encourages polluters to invest in the most efficient pollution abatement measures, including pollution prevention. In fact, some countries have adopted import duty waivers for environmentally cleaner industrial process technologies. The increasing use of pollution prevention has the potential in the future to alter the technological needs of industrial wastewater treatment.

E-Business

In many industries, the Internet has already made many changes in the way business is conducted. However, e-commerce has not had the same dramatic impact on the water industry, either in business-to-consumer (B2C) or in business-to-business (B2B) applications. In 1999, only 18 percent of water treatment equipment manufacturing

companies had Web pages and only 0.2 percent had on-line ordering capability.²² A survey of 100 of the largest water utilities in the United States determined that less than 5 percent had the capability for customers to access and pay their bills over the Internet.²³

Nevertheless, the water industry has made advances in e-commerce, beginning with basic on-line catalogues where utilities and other businesses can review equipment specifications and make purchases directly from manufacturers. Auction sites have also been developed to facilitate used equipment sales. However, to date much of the business transacted on the Internet has been for commodities, typically equipment for maintenance, repair, and operations.

Recently, several companies have attempted to take the next step in B2B transactions by establishing digital marketplaces or e-hubs, which are designed to allow for more complex transactions such as requesting qualifications and proposals for engineered products, along with on-line tracking of procurements. At least one e-hub has already expanded its services to include trading of water rights between parties. Two e-hubs now operating in the water industry are VerticalNet's Water Online, and Azurix's WaterDesk.

Employing e-commerce in lieu of traditional procurement vehicles can save both time and money for water utilities, as well as for the manufacturers of equipment. Estimates of savings for the procurer in other industries range from 2 to 39 percent.²⁴ Fulfillment cycles can be reduced by two-thirds, as can administrative costs; and inventory costs of manufacturers can be reduced by 25 to 50 percent.²⁵

22. "The U.S. Water Industry," *Environmental Business Journal*, vol. XII, no. 7/8, 1999.

23. Survey by PA Consulting Group, July 2000.

24. "B2B: 2B or Not 2B?" version 1.1, part 1 of 5, Goldman Sachs, November 12, 1999.

25. Aberdeen Group, June 1999.

Chapter 2

U.S. Competitive Position in the Market

The annual growth of the U.S. water and wastewater equipment and services industry between 1999 and 2003 is estimated at about 8 percent. While the domestic market for water equipment is growing very slowly (by 1 percent in 1999), the industry's expansion in this market segment translates directly into the fast growth in exports, which went up from 26 percent of the total production volume in 1998 to 29 percent in 1999 (or about \$5.9 billion).²⁶

Despite this promising growth in exports, the vast majority of U.S. water companies are still focused on the North American marketplace and lack the capacity to compete for large global projects with European and Japanese firms. This chapter looks at the competitiveness of U.S. firms vis-à-vis their main business rivals from other countries in different water and wastewater industry segments and in different regions of the world.

Major Foreign Competitors

The major players in the global water and wastewater industry come from the United States, France, the United Kingdom, Japan, and Germany. Integrated, global companies generally have a competitive edge over U.S. firms that are smaller, more specialized, and operate in an environment in which information is often protected rather than shared. European water companies that have more experience in operating and serving privatized or partially privatized facilities will have a competitive edge in emerging markets where water and wastewater sectors are undergoing privatization.

U.S. companies are generally competitive in the water equipment and chemicals market segment but face very tough competition from French, British, and Japanese firms. In the area of water and wastewater treatment works, the market is dominated by French and British companies. In particular, companies from France and the United Kingdom are by far the most competitive in providing integrated packages that include designing, building, managing, and even owning water infrastructure.

26. "The U.S. Water Industry," *Environmental Business Journal*, vol. XII, no. 7/8, 1999.

Table 2.1 contains the list of the top ten water companies in the world. Two French companies, Vivendi and ONDEO, are by far the largest, while other competitors to U.S. firms occupy almost all the other positions on the list.

France

In France, municipalities are responsible for water and sewerage services, either by providing those services themselves or, more commonly, contracting them out. The private sector's share in drinking water supply has increased from about 30 percent in the mid-1950s to 77 percent in the late 1990s, and about 60 percent of the wastewater market is operated by private companies.

This move to private management in France has led to the emergence of the two largest full-service water companies in the world: Vivendi with over \$20 billion in revenues in 2000 and ONDEO with \$6.3 billion in revenues in 2000. These firms represent the result of significant horizontal integration in the French water business. In the late 1980s, there were five private water

27. Thames Water became part of Germany's RWE Group in September 2000.

Table 2.1. Top 10 Water Firms in the World, 2000

<i>Rank</i>	<i>Company</i>	<i>Country</i>	<i>Water-Related Revenues, \$ billion</i>
1	Vivendi	France	20.5
2	ONDEO	France	6.3
3	Ebara Corporation	Japan	4.3
4	Hercules, Inc.	United States	3.1
5	Severn Trent	United Kingdom	2.5
6	Thames Water ²⁷	United Kingdom	2.2
7	Aguas de Barcelona	Spain	1.7
8	AWG (Anglian Water)	United Kingdom	1.4
9	United Utilities	United Kingdom	1.4
10	American Water Works Co.	United States	1.3

Source: Hoover's Online (www.hoovers.com).

companies; today, there are three. Vivendi, SAUR, and ONDEO contract with the local municipalities to operate water services and build new facilities. Both Vivendi and ONDEO have grown into global conglomerates, having leveraged their capital to expand from infrastructure management services to water equipment manufacturing and even such sectors as hazardous and solid waste management, and telecommunications.

Vivendi is the world leader in revenues received from drinking water distribution. With the acquisition of U.S. Filter in 1999, Vivendi became the world's largest water company with 1999 net sales of 10.7 billion euros in the water and wastewater sector. In addition, the firm controls approximately 40 percent of the water and 30 percent of the wastewater markets in France. Vivendi currently operates in 100 countries and employs 275,000 people.

ONDEO has a long history of involvement overseas. In 1914, the company was active in North Africa, Central Africa, and the Pacific. From 1980 to 1990, it expanded internationally in the water and wastewater sector, mainly in the United Kingdom, Spain, and the United States. In 1993, the company won contracts in Argentina and Australia, and intensified international development in 1997 with water contracts in the Philippines, Hungary, Morocco, and Indonesia. In 1997, Compagnie de Suez merged with Lyonnaise des Eaux, becoming Suez Lyonnaise des Eaux. The newly named company joined with United Water Resources, Inc., a U.S. company, and each acquired a 50 percent interest in United Water Services. With this merger, the company now manages water works for municipalities and local utilities, mostly in the northeastern United States. In 1999, the company acquired all of United Water Services. In 2001, the water division of Suez Lyonnaise des Eaux changed its name to ONDEO. ONDEO also owns Nalco Chemical, the top water chemical company.

With more than 201,000 employees, ONDEO serves over 100 million people in over 120 countries: 32 million in North America, 42 million in Europe, 18 million in Asia, 5 million in Africa, and 22 million in South America. The company is also Europe's fifth-largest private electricity supplier and a leader in waste services and cable in France and Belgium. In 1999, the group's core businesses generated 43 percent of its revenues outside France and Belgium; by 2002 the goal is to increase this figure to 50 percent.²⁸

Several key factors have enabled Vivendi and ONDEO to be successful in the international water and wastewater markets. First, the concession mechanism that has

been used in France is being modeled throughout the world, which has given these companies a competitive edge in bidding on these types of projects. Second, these companies are integrated, providing potential clients a full package, including experience in operating and maintaining facilities as well as collecting fees. Third, French companies have an advantage in terms of investments in long-term water projects, because French stock owners include banks and large financial institutions that can afford longer-term investment approaches, which are usually necessary for water and wastewater treatment-type projects. In contrast, U.S. companies are driven by profitability and individual investors who cannot afford or do not wish to take such a long-term approach. Finally, the French giants have been able to conduct market intelligence work to edge out competitors in bidding processes, with substantial support from French foreign embassies. Given their experience, access to capital, and market intelligence, these large firms are formidable competitors.

Both Vivendi and ONDEO have substantial holdings in U.S. water and wastewater companies. Vivendi's U.S. presence includes not only U.S. Filter but Air and Water Technologies Corporation and numerous other companies in water equipment and water-related instrumentation.

United Kingdom

In 1989, the Water Act restructured the water industry and privatized the water and wastewater operations of the 10 water authorities in England and Wales. The privatization was motivated in part by the need for an enormous investment of resources to bring the infrastructure up to the European standards. From 1990 through 2000, the private water industry invested over \$52 billion in water and wastewater system infrastructure improvements (see the section on the United Kingdom in Chapter 4 for more information about the U.K. water and wastewater market).²⁹ The market liberalization at home has positioned several of the larger British firms such as Thames Water, Severn Trent, and AWG (formerly Anglian Water) to successfully compete in the international market.

Notably, several British companies have formed alliances with leading U.S. companies in order to access the U.S. market. These include:

29. *Financial Performance and Expenditure of the Water Companies in England and Wales: 1999–2000* (Birmingham, United Kingdom: Office of Water Services, 2000). Available on the Internet at www.opfwab.gov.uk/pdf/capex2000.pdf.

28. ONDEO's Internet site (www.ondeo-nalco.com).

- A joint venture between AWG and American Water Works Company to pursue the privatization of municipal wastewater services in the United States.
- Ownership of several U.S. equipment and services firms, including PSC Environmental Services, by Severn Trent.
- A joint venture between the Kelda Group (formerly Yorkshire Water) and Ogden.

Japan

Japanese water and wastewater companies tend to be highly integrated and fairly concentrated. Leading Japanese firms are technology- and equipment-oriented and compete as conglomerates or trading companies in which every component required for a project is included—consulting, engineering, construction, equipment, supplies, materials, and financing.

The \$4.3 billion Ebara Corporation offers the most diversified portfolio of water and wastewater equipment and services, including equipment for all types of treatment processes, chemicals, sludge handling equipment, as well as plant design and construction, and process engineering and consulting services. Pump manufacturing is Ebara's major business, and its manufacturing bases worldwide (Japan, Taiwan, Indonesia, Brazil, Italy, and Spain) offer customers competitive prices and short delivery periods.

The smaller Kurita Water Industries specializes entirely in the water market but focuses primarily on ultra-pure water production for the electronics industry, membrane filtration and desalination equipment, water recycling technologies, and chemicals. Mitsubishi Heavy Industries has a large machinery and plants manufacturing business that produces, among others, package water, sewage, and industrial effluent treatment systems, pumps, and desalination plants. The Kubota Corporation is a major manufacturer of pipes for water supply and sewerage systems.

The Japanese government actively supports the development of business opportunities for Japanese firms by providing attractive financing along with technical assistance to promote their products.

Germany

German companies involved in the water and wastewater sectors are best known for their construction and engineering services, although a few German firms have also been active in bidding on BOT projects. As Germany's domestic market is limited, companies have had to look overseas to survive.

German companies are also consolidating to provide a more complete range of products and services in the international water and wastewater market. For example, RWE Group AG, a conglomerate of German utilities, offers a range of technical and financial expertise in the design, construction, and operation of waterworks. In September 2000, RWE took over Britain's Thames Water to become one of the world's largest water companies.

Competition by Geographic Area

Traditionally, U.S. companies have been most competitive in Latin America (particularly Central America), due to its geographic proximity and the fact that they are usually able to conduct their business in Spanish. However, giant French water companies have recently become very competitive, particularly in South America, due to their ability to take advantage of market opportunities created by the growing water utility privatization there. Japanese water equipment firms have also been active in South America, supported by the Japanese government's aid programs.

Although U.S. firms have a significant market share in water and wastewater equipment supplies in Europe, this share is unlikely to expand. The pan-European integration process that has extended to Central and Eastern Europe creates advantages for European firms.

In Asia, U.S. competitiveness is largely determined by the political relationships the U.S. government enjoys with individual countries and the corresponding amount of U.S. foreign aid going there. U.S. companies are most competitive in the Association of Southeast Asian Nations (ASEAN) countries: Indonesia, Malaysia, Thailand, the Philippines, and Singapore. In China and India, the United States is becoming more competitive as the bilateral political climate improves. Japanese and, to a smaller extent, French and British firms are the main competition in that part of the world.

A similar situation exists in the Middle East, where the U.S. government has been pouring foreign aid into water projects in Egypt, Jordan, and, since recently, Palestine, thereby creating advantages for U.S. water and wastewater equipment suppliers. The strategic partnerships between the United States and Saudi Arabia, and a number of smaller Gulf states also have a positive impact on the competitiveness of U.S. exporting firms. On the contrary, there is virtually no American business presence in "unfriendly" countries like Syria, Iraq, Libya, etc. In the Maghreb countries of North Africa (Morocco, Algeria, and Tunisia), U.S. firms' competitiveness is impaired by the need to conduct business in French and

compete with well-connected French companies. In general, across the Middle East and North Africa, European firms, particularly French and German, are very tough competition.

Finally, Africa has never been a priority region for U.S. exporters of water and wastewater technologies, partly because of the competition from the French and British firms in their former colonies, and partly because of the risky political and business climate in the region. Several U.S. firms are now trying to explore opportunities in Africa created by the international efforts to provide safe drinking water to the population.

Competitiveness by Market Segment

U.S. companies are major exporters of water and wastewater equipment and chemicals. Overall, U.S. firms seek to compensate for the high risk of working in overseas water and wastewater markets through higher profitability of their exports. This makes industrial wastewater projects generally more attractive for them. While U.S. firms would probably not be competitive on price alone, they rely on the recognized quality of their work and their technological sophistication and reputation. Often, U.S. firms produce specialty equipment that is not available from other suppliers, which gives them a competitive edge in certain niche markets.

At their October 1999 meeting, representatives of the U.S. environmental industry, non-profit organizations, and the federal government identified the following areas where U.S. water companies have substantial competitive advantage:³⁰

- Micro-level water and wastewater treatment systems, especially decentralized packaged systems using membrane filtration, reverse osmosis, molecular sieve, and hollow fiber separation technologies;
- Water and wastewater testing technologies; and
- Industrial process control technologies.

It is difficult to estimate export volumes of specific water technologies, mainly because traditional classification methods are not yet geared specifically to environmental technologies. Therefore, some, if not most

harmonized tariff schedule (HTS) codes³¹ designated as environmental items in the U.S. Department of Commerce's September 2000 classification also include products intended for non-environmental applications.

According to rough estimates based on the 1999 HTS code data for U.S. exports, biological wastewater treatment equipment is by far the largest export category for the U.S. water industry. The other principal exports include ozone generators, filters, pumps (including mixer, centrifugal, and vacuum pumps), as well as measuring and testing equipment.

France, the United Kingdom, and Japan remain the major competitors in the global market for water equipment and chemicals. Germany and the United States also have a sizable market share.³²

Process Equipment

Process equipment includes separation, mixing, destruction, and chemical feed equipment for municipal and industrial water and wastewater treatment. Overall, the market for U.S.-manufactured process equipment should continue to grow, especially if destruction technologies replace some existing separation technologies (for example, advanced oxygen technology vs. carbon adsorption). Potential export markets for process equipment are dependent upon the development of environmental regulations in importing countries; as these countries develop increasingly stringent regulations, more advanced treatment technologies and process equipment will be needed.

Canada is the most lucrative foreign market for U.S. water treatment process equipment firms primarily because of its proximity to the United States and the strong ties between U.S. producers and the end-users, Canadian municipalities. Mexico is the next most lucrative market for U.S. process equipment for largely the same reasons, followed by the United Kingdom and Central and Southern Europe.

U.S. companies are not seen as being highly competitive in the market for emerging process technologies (for example, membrane and advanced oxidation technology). Two Canadian companies (Trojan Technologies and Zenon) dominate the North American market. Competing against these major Canadian exporters of water and wastewater treatment process equipment are German, French, Japanese, and Dutch companies.

Two highly successful U.S. ultraviolet industrial water treatment companies have been bought outright or have entered into joint ventures with the German giant WEDECO GmbH based in Dusseldorf. Ideal Horizons

30. "Global Environmental Markets 2000," *Environmental Business Journal*, vol. XII, no. 9/10, 2000.

31. The Harmonized Tariff Schedule of the United States is published by the U.S. International Trade Commission based on the international Harmonized System, the global classification system that is used to describe most world trade in goods.

32. Ibid.

(based in Poultney, Vermont) has been bought by WEDECO and is known now as WEDECO-Ideal Horizons. The firm remains prominent in the area of industrial process water UV disinfection systems, as well as residential and commercial units for home and office use in North America.

Aquafine (based in Valencia, California) is competitive overseas in the area of ultraviolet water treatment equipment for pure and ultra pure applications (for example, the semiconductor and pharmaceutical industries). However, even successful companies like Aquafine are entering into multinational relationships to increase market exposure. Aquafine has recently formed a joint venture with WEDECO. The new company, Aquafine Wedeco Environmental Systems, Inc., will manufacture and sell WEDECO's ozone generators, ultraviolet disinfection and oxidation systems, and fixed-film biological treatment equipment in North America and Mexico.

Delivery Equipment

Export of delivery equipment (pumps, pumping equipment, industrial valves, pipes, storage tanks, etc.) is constrained by the fact that these products are heavy and do not have high profit margins. As a result, the high cost of shipping and delivery leaves little room for profitability.

Although the United States is the world's single largest producer of water and wastewater delivery equipment, only 10 percent of all U.S. delivery equipment revenues

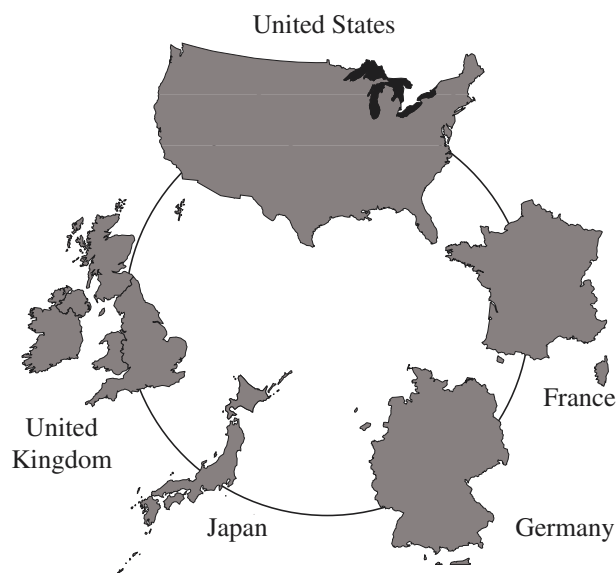
is from exports. The European Union produces twice the amount, in gross sales, of pumps and pumping equipment, compared to the United States. Delivery equipment industry leaders include firms in the United Kingdom, France, Germany, and Japan, with Germany being the largest producer. Most German firms in this business are medium-sized and specialize in one or two branches of the delivery equipment market.

Two U.S. companies have proved to be competitive in the market for pumps: Gorman Rupp and Gould. Gorman Rupp produces pumps for the industrial, municipal, sewage, construction, and petroleum markets. Gould makes pumps for the industrial and water technology sectors. They are known for producing the world's leading line of residential water well pumps. These two companies have positioned themselves well, and are competitive with the Swiss and German pump companies. Gorman Rupp has even managed to make inroads into the northern European markets.

Many mergers, acquisitions, and consolidations have been occurring in this market segment. In France, the major integrated firms, specifically Vivendi and ONDEO, are involved in the water and wastewater delivery equipment market through subsidiaries. Many British delivery equipment producers are also mechanical engineering firms.

Japan has shrunk its domestic production, so its competitiveness may have increased elsewhere. Japanese firms generally do not export or market delivery equipment exclusively, but instead rely on government technology transfer programs for developing countries. Japan is the largest distributor of water and wastewater delivery equipment in the Asia Pacific region, followed by the United States and the European Union.

Figure 2.1. Top Delivery Equipment Producing Countries



Source: "Global Environmental Markets 2000," *Environmental Business Journal*, vol. 12, no. 9/10 (Sept./Oct.2000).

Chemicals

Chlorine, the most prominent chemical used in water treatment, is produced virtually worldwide. Activated carbon, another large-volume product, is produced primarily in Japan, Belgium, France, Germany, Italy, the Netherlands, and the United Kingdom (as well as the United States). To a lesser extent, activated carbon is also produced in East Asian countries. Two other common water treatment chemicals, aluminum sulfate (alum) and calcium hydroxide (slaked lime) are produced throughout the world. In 1998, U.S. companies exported over 8,000 tons of alum, and more than 6,800 tons of slaked lime.³³

The fastest growing part of the water treatment chemical industry is specialty chemicals for advanced water

33. *Export Commodity Report*, Oregon State University, 1994–1998.

Table 2.2. Global Specialty Water Chemicals Market, 1998 (millions of U.S. dollars)

<i>End User</i>	<i>North America</i>	<i>Western Europe</i>	<i>Japan</i>	<i>Other</i>	<i>Total</i>
Heavy Industry	1,700	900	450	500	3,550
Light Industry	700	300	150	100	1,250
Commercial Sector	600	140	100	50	890
Municipal Utilities	200	160	100	50	510
Total	3,200	1,500	800	700	6,200

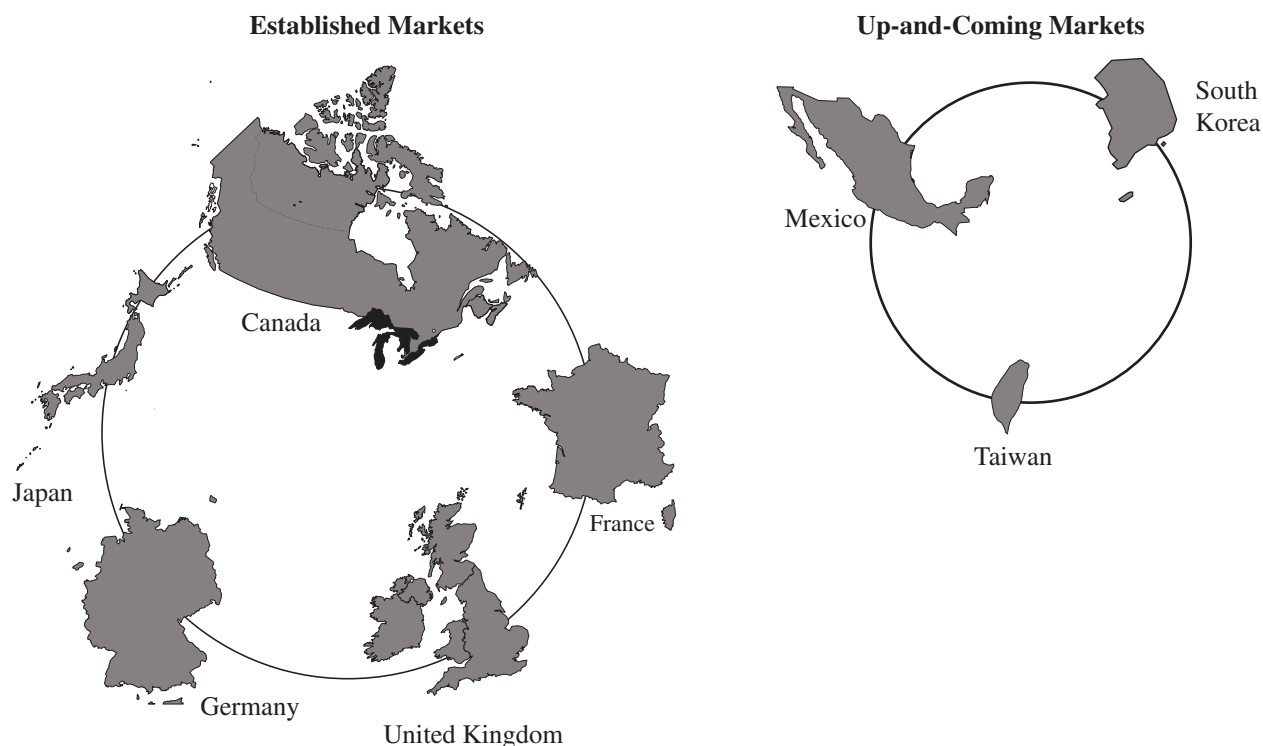
Source: Environmental Business International, 1999.

and wastewater treatment systems. Specialty chemicals, such as certain polymeric materials used in filtration devices, are produced mainly in the United States, Japan, and Western Europe.

The total global market for specialty water management chemicals was estimated at \$6.2 billion in 1998 and is growing at 3.2 percent per year, with North America comprising more than half of this market, followed by Western Europe and Japan (see Table 2.2).³⁴ The European market is approaching saturation, while the

largest growth opportunities should arise in developing countries.

The United States exports more chemicals than most other countries—20 percent of U.S. companies' total revenues from water chemicals are generated by exports. Canada is the largest export market for the United States, followed by Japan and Mexico. Nearly 45 percent of total U.S. exports of water and wastewater treatment chemicals consist of activated carbon and ion exchange resins.

Figure 2.2. Best Prospect Markets for Instrumentation

Sources: "Global Environmental Markets 2000," *Environmental Business Journal*, vol. 12, no. 9/10 (Sept./Oct. 2000); U.S. International Trade Commission, *Global Competitiveness of U.S. Environmental Technology Industries: Municipal and Industrial Water and Wastewater*, publication no. 2867 (Washington, D.C.: U.S. ITC, March 1995).

34. "The U.S. Water Industry," *Environmental Business Journal*, vol. XII, no. 7/8, 1999.

Instrumentation

The United States is the world's largest producer of water and wastewater instrumentation. U.S. environmental instrument manufacturers generate more than a third of their revenues from water and wastewater applications. While the U.S. instrument industry is competitive in domestic and foreign markets, particularly due to high levels of investment in research and development, technological sophistication, after-sales service, and competitive pricing, it has been experiencing increased competition from foreign firms in recent years.

Several U.S. instrument manufacturers have production and distribution capabilities in many industrialized countries (for example, Germany, Britain, Japan, and Canada). Most water and wastewater instrumentation is produced by a large number of medium-sized and small companies. Smaller companies involved in the instrument sector typically market their instruments through independent distributors, while the larger companies generally market directly to end users.

To date, the majority of U.S. instrumentation exports have gone to Canada, Japan, Germany, France, and Britain. At the same time, exports to emerging market nations, such as Mexico, South Korea, and Taiwan, have grown twice as fast in recent years as exports to OECD markets.

The quality of instrument production in countries like Britain, France, Italy, Germany, and Japan is comparable to that of the United States. About 55 percent of the world's process control instruments, analytical instruments, and on-line analyzers are produced by manufacturers in these countries, along with about 80 percent of water meters. Germany is the largest producer in the European Union, accounting for 50 percent of the production volume.³⁵

Engineering and Construction Services

U.S. engineering and construction firms are well known around the world for their expertise and quality of their work. Large design firms such as Montgomery Watson, Black and Veatch, and Earth Tech remain leaders in revenue from international water and wastewater projects. They share this distinction with NEDCO (Netherlands) and Dar Al-Handasah (Egypt).³⁶ Over the past

several years, with the downturn in the Asian and Brazilian economies, the international design market wavered and has yet to return to steady growth. The market is becoming more complex with international acquisitions and diversification into integrated service providers, meeting the design-build-turnkey needs of international clients. For example, Earth Tech, a global environmental and engineering technology company owned by Tyco International, has grown in the water market through varied acquisitions. Earth Tech's acquisition of Brazil's Multiservice Engineering Ltd. in 1998 opened up privatization opportunities in Latin America, the company's primary area of focus. Similarly, the 1999 purchase of the British firm Babcock Water Engineering was an essential step in Earth Tech's business development in Western Europe.

International contracting is continually plagued by risk, as confirmed by the financial troubles of Stone and Webster (purchased by the Shaw Group in 2000), and Germany's Philipp Holzmann, and South Korea's largest contractor, Hyundai Engineering and Construction. Nevertheless, the \$2.5 billion of international wastewater construction activity in 1999 was led by the U.S.-based Bechtel Group, Inc., followed by Skanska AB (Sweden) and Ed. Zublin AG (Germany). The \$3.2 billion international water construction activity was led by Italy's Impreglio, SPA, followed by the Dragados Group (Spain) and Vinci (France). The future water and wastewater opportunities appear to be favorable in some Asian countries such as South Korea, Japan, and Taiwan, Eastern Europe, and the Middle East.³⁷

Foreign firms providing engineering and construction services in the water and wastewater sectors, especially those in France, the United Kingdom, and Germany, tend to be larger and more integrated than those in the United States, and typically concentrate on these sectors. For example, Germany's RWE Group (which has recently acquired Britain's Thames Water) offers design and construction services for water and wastewater treatment plants but is also a supplier of water-related products and other environmental services. When project specifications call primarily for engineering and construction services, U.S. companies are very competitive; however, when clients are looking for a turnkey project, integrated firms such as Vivendi, ONDEO, and RWE often have an advantage.

35. *Global Competitiveness of U.S. Environmental Technology Industries: Municipal and Industrial Water and Wastewater*, U.S. International Trade Commission, 1995.

36. "The Top 200 International Design Firms," *Engineering News Record*, July 17, 2000.

37. "Slow Growth, High Hopes," *Engineering News Record*, August 14, 2000.

Chapter 3

Increasing Competitiveness of the U.S. Water Industry

In order to succeed in the international market for water and wastewater technologies and services, U.S. firms should be aware of the realities of doing business overseas, know and be able to take advantage of particular market characteristics, and use available information support services.

A recent survey of the San Francisco Bay area's environmental technology exporting firms³⁸ sought to identify critical success factors in overseas markets. In the survey, the following four themes were mentioned most frequently by the exporting companies:

- Understanding country markets, or becoming familiar with a specific country, its culture, work habits, and language;
- Building alliances and working effectively with partners in export countries;
- Access to financing for export activities; and
- Having experienced in-house staff dedicated to exporting.

This chapter presents market strategies for three of these success factors (staff dedication is a matter of internal company policies and is not considered here). It also describes other competitiveness strategies such as building joint ventures and consortia with U.S. and third-country firms. It provides important hints on how to enter and compete in promising overseas markets and how to pursue international water and wastewater projects. It also refers exporters to the information resources available through a multitude of U.S. public sector service organizations.

Understanding Local Markets

The first step in a successful export market strategy is knowing where the markets are and how to access them. To a "new-to-market" company, export markets can seem daunting and inaccessible, particularly from an office in the United States. The most successful companies, be they

large or small, are those that do their homework. Knowing the stage and pace of market development as well as the local business culture is critical in prioritizing business development efforts. Many companies find that to gain substantial market share, they must be the first one on the ground in the targeted country, which often involves years of education and product orientation prior to any direct sales. Because of the large amount of time and resources required for this approach, many early market opportunities are available only to the larger U.S. water and wastewater equipment manufacturers.

Host Government Regulations

Successful exporting requires an in-depth understanding of host government regulations and an understanding of how these regulations are implemented.

Case Study 3.1. Developing Water Projects in Emerging Markets: What Does It Take to Succeed?

Thierry Baudon, Managing Director of ONDEO's International Finance Division, identified five success factors in emerging water and wastewater markets:

1. Develop superior technical and customer management skills, through continuous research.
2. Develop a thorough understanding of the local environment, including the local institutions, politics, and civilian society.
3. Develop strong industrial and financial partnerships (with local business partners, international investors, and multilateral financial institutions).
4. Develop innovative financial engineering capabilities and risk management techniques.
5. Construct a corporate culture that rewards pioneering attitudes, strong ethics, and decentralized decision-making.

Source: T. Baudon, "Developing Water Projects in Emerging Markets: What Are the Challenges and What Does It Take to Succeed?" *Global Infrastructure Development: World Markets in 1999* (Standard and Poors, 1998).

38. "Global Environmental Markets 2000," *Environmental Business Journal*, vol. XII, no. 9/10, 2000.

Developing an understanding of local institutional, regulatory, and decision-making processes and frameworks, as well as establishing local political connections and partnerships, are critical steps to achieving success in export markets.

Most countries have business registration requirements, and tax and business issues that can be very unfamiliar to American companies. Many countries also require local incorporation. These requirements are not real barriers in most instances, but sometimes appear to be as approvals move slowly. Restrictive business practices, such as requiring local ownership of the majority of the business, are fading away in most countries, in part due to the trend of globalization.

Since water and sewerage services are usually the responsibility of municipalities, there are relatively few bureaucratic hurdles for exporters to overcome. The industrial sector, on the other hand, is typically regulated at the national level through central or regional offices. Factories that have been targeted by the authorities and are subject to enforcement actions often represent attractive opportunities to market industrial wastewater treatment equipment. Therefore, it is important to monitor the target country's regulatory developments in the water sector.

Local Business Culture

U.S. businesses often find that local business customs and norms, as well as cultural practices, present more of a challenge to exporting than many of the bureaucratic hurdles. Establishing, maintaining, and expanding business overseas can be particularly frustrating because of the volume of communication required. Many companies identify a lack of understanding of the local culture as being a key factor in the difference between a successful and a failed business negotiation.

Some of the most challenging areas for U.S. businesses are different notions of property and acceptable levels of risk, and different tax and contract laws. Local partners often do not understand the need to address these risks, or simply want the U.S. firm to bear all the risks. Again, good communication is necessary to work out these issues with the local affiliate.

U.S. companies have also long complained about the bribes and gratuities that officials in some countries expect for anything from copies of bid documents and key data, to final award of a contract. In some European countries, such payments are considered legitimate business expenses. U.S. firms typically must market on quality and price only, and cannot offer such gratuities due to the Foreign Corrupt Practices Act.

To avoid some of the problems discussed above, U.S. businesses should take advantage of the available resources to learn about the local business culture and to recruit the help of a local business advocate. For more details, see Appendix D.

Market Intelligence Information

A successful export market strategy relies on good information about the target overseas market conditions, competitors, business culture, and specific needs and opportunities. The importance of developing an export strategy cannot be overstressed. Many small and medium-sized businesses, however, lack the resources or expertise to export on their own. In addition, many smaller companies find it difficult to develop an export strategy. The case study below illustrates the difficulties in exporting without a comprehensive, well-designed overseas marketing strategy.

Case Study 3.2. Pipe Repair Manufacturer Export Activities Limited by a Lack of Strategy

An American-owned and Texas-based company manufactures fittings and fabrications for the repair, connection, and branching/tapping of all types and sizes of pipes. Their products are used for water, wastewater, industrial, and manufacturing piping, as well as for irrigation and natural gas pipelines. Currently, the company has 160 employees and 2 to 3 percent of its business is international. The company's limited successes exporting repair products have been in the border regions of Mexico, Panama, and the Caribbean.

The company began exporting approximately five years ago when Mexican clients heard about it from colleagues in the Caribbean. Since then, however, it has not developed an export strategy to solidify and expand its international presence.

The company relies on contacts made at national and international expositions to find leads and often waits for those who have expressed interest to call. In addition, it does not have a formalized process for finding local affiliates. The company has tried using a sales representative, but the mixed results have made it disinclined to rely as heavily on this approach. All of this suggests a poorly formed export strategy.

The company wants to use its existing base to strengthen its presence in Central America, but is likely to continue to face substantial obstacles until it develops a strong marketing strategy.

Source: Primary interview with company staff.

Gathering information on the market can be done with limited travel and expense by using e-mail, the Internet, a telephone, and a fax machine. U.S. government assistance programs provide several types of information that can be useful for U.S. companies seeking market intelligence, including:

- Market reports (produced by the Department of Commerce and USAID), as well as *Country Commercial Guides* published by the Departments of State and Commerce for many countries (see Appendix D for more information); and
- Information from in-country U.S. Commercial Service Representatives and/or Technology Representatives supported under USAID's U.S.-Asia Environmental Partnership (US-AEP) and Ecolinks initiatives (see Appendix B for more details).

Other sources that can provide market intelligence information include the World Trade Centers Association, an association consisting of over three hundred trade centers worldwide, international accounting firms, as well as many consulting firms. For some companies, having access to proprietary information that gives them the edge over competitors is a worthwhile marketing investment, despite the steep costs. A company can utilize these resources to begin to identify and prioritize country markets for particular products or services. At the same time, firms can learn which U.S. and foreign companies are active in the country and evaluate their competitiveness.

Companies can also take advantage of trade promotion opportunities, including catalogue shows, trade missions, agent distributor searches, and the U.S. Department of Commerce's Gold Key Program, which help U.S. firms access overseas markets.

Positioning to Enter the Market

When positioning themselves to enter foreign markets, companies must consider the differences in legal, political, and social environments between home and host countries. Developing an understanding of a foreign country's business climate and customs is often greatly assisted by developing local relationships.

Exporting firms can use two principal strategies in order to increase their competitiveness or establish a local presence:

- Establishing local representation and partnerships, and
- Engaging in joint exporting activities (through joint ventures or consortia) with other U.S. firms.

The case study of Komline-Sanderson (see Case Study 3.3) is an example of a medium-sized company that has effectively positioned itself overseas by remaining flexible, seizing opportunities when they arise, and developing strong relationships with its foreign colleagues.

Case Study 3.3. Komline-Sanderson: Small Company Effectively Develops New Export Opportunities

Komline-Sanderson of Peapack, New Jersey, is a medium-sized business that makes water quality instruments, primarily for liquid/solid separation. It has been working to develop overseas opportunities for its products. Currently, 10 to 15 percent of the company's business is with foreign industrial and municipal clients.

Komline-Sanderson has found its small size to be both a detriment and a benefit when exporting overseas. As Jabez Van Cleef, director of communications, stated in the *Environmental Business Journal*, "our size constrains us from building an extensive service and information infrastructure overseas, but it permits us to respond quickly if a market opportunity presents itself."³⁹

Komline's flexibility has made it possible for it to get a foothold in new markets. The company has been content to sell different products to different markets and to use these footholds as a "springboard" into neighboring and other product markets. For example, it is currently selling industrial process and filter technology in Mexico, machinery for sludge concentration in municipal wastewater treatment in the United Kingdom, and filters for corn-syrup processing in China. Now the company's associates in China and Mexico are actively working to develop the municipal wastewater side of the business.

Driven by the idea that building a relationship of trust is key to successful exporting, the company's marketing strategy has benefited from the company's small size. Also, unlike the competition, Komline is unwilling to "oversell" its products and prefers instead to be forthright about such things as product lifetime. This honesty and the relationship of trust KS develops with its clients will further assist the company's export efforts.

For further information, visit the Komline-Sanderson Web site at www.komline.com.

39. "Wastewater Instrument Firm Sees Opportunity Abroad," Global Environmental Markets 2000, *Environmental Business Journal*, vol. XII, no. 9/10, 2000.

Building Local Relationships and Establishing a Local Presence

Local partnerships and representation not only provide U.S. firms with the advantage of learning about opportunities before their competitors, but also provide a source of inside information on local business culture. Establishing a presence in a country requires both time and investment of human and financial resources. Some type of “foreign presence” accounts for approximately 95 percent of foreign sales of water treatment and infrastructure equipment and systems.⁴⁰

Methods for establishing local presence range from hiring a local consultant or agent to represent the firm, to setting up a local office. Perhaps the most common arrangement is to establish a relationship with a local business that has both a good reputation and solid industry contacts. This company can then effectively market and distribute the American company’s product for a percentage of the profit.

In exploring the options for local representation, the firm must determine which option is the most viable given its financial and human resource limitations. U.S. companies should also be familiar with the host country’s rules and regulations concerning the establishment of local offices and partnerships with local organizations. Valuable information can be found in the U.S. Department of State’s *Country Commercial Guides*.

There are several ways U.S. companies may establish a local presence in a developing country market:

- **Agents.** U.S. equipment manufacturers may establish relationships with agents to import and sell their products in the local market. There are a number of U.S. government programs (see Appendix D) that assist exporters in finding local agents and distributors.
- **Local Office.** Establishing a local office helps companies respond faster to sales opportunities. In equipment sales, a local branch can provide comprehensive service from the customized design and installation of a technology to technical support and after-sale maintenance. For a long-term commitment to a region or a country, a local subsidiary may lead to the best results. This strategy is generally also most effective for bidding on large infrastructure or technical assistance projects sponsored by USAID, the World Bank, and other donors whose tenders are open for U.S. companies.

- **Joint Venture.** U.S. companies may want to establish a joint venture or partnership with a local firm. Local firms bring critical familiarity with the in-country regulatory environment and exclusive technical knowledge important in adapting U.S. technologies and engineering to local conditions. In some countries, regulations require a link with a local firm, or even call for foreign companies to limit their participation to minority status. Local firms tend to provide cost-effective resources, allowing U.S. companies to be more competitive. This also allows access to projects that are bid in the country itself. Knowing the local partner and his/her credibility is critical to successful partnerships and projects. Another critical factor is that of commitment, or a willingness to participate, on the part of the local partner. It is recommended that a firm conduct due diligence on its prospective partners, for it is much easier to form a partnership than it is to dissolve one. The costs of breaking ties with a local firm can cost a U.S. company its reputation in the local market.
- **Partnership with a Third-Country Firm.** U.S. firms may choose to enter a country market through a partnership with a third-country firm that has strong local representation. For example, teaming with Indian firms can help U.S. companies gain access to other Asian markets. Teaming with European or Japanese firms that already have a substantial market share in the country may also prove beneficial.

The Hach Company has successfully built an export business that relies on close relationships with distributors abroad. Their case is presented below.

Joint Exporting Partnerships

Before entering an overseas market, U.S. firms must decide whether they are able to enter that market and whether it is worthwhile to do so—in terms of ability to compete and resource availability. By exporting in partnership with each other, U.S. firms can increase their competitiveness and each firm can benefit from lower individual export costs and increase its efficiency in every phase of exporting. Multinational companies can be important partners for small and medium-sized environmental firms seeking to supply goods and services to large donor-financed projects but unable to bid on such projects directly. Small and medium-sized enterprises can often provide niche services that will serve as an asset to a larger firm and increase the likelihood of overall success. Firms of all sizes and levels of international business ex-

40. *Competitive Analysis of U.S. Environmental Exports and Global Market Update*, Environmental Business International, 1995.

Case Study 3.4. Building a Network of Top-Notch Local Distributors: The Hach Company

“The advantages of entering into distributor and dealer relationships far outweigh the costs,” says Paul Goltz, director of international sales and marketing, The Hach Company.

The Hach Company of Loveland, Colorado, is an internationally recognized manufacturer and distributor of analytical instruments and reagents used to test the quality of water and other aqueous solutions. The company employs almost 1,000 people in the United States and has been selling its products overseas since the 1950s. Hach has built a professional distributor network in over 100 countries; most dealers and sales representatives have well over 10 years of service working with the Hach Company and building markets for its products.

The Hach Company believes that strong local relationships are key to export success. Local affiliates fulfill such critical functions as negotiating new and sometimes frustrating business climates, arranging payment, and addressing tariffs and other barriers.

The Hach Company has established a formal process for selecting and training local distributors, but it also believes that the enthusiasm and capability of the selected local affiliate is critical. Hach representatives look for key characteristics such as honesty, motivation, and a strong commitment to growth.

Hach identifies dealer prospects through the Agency/Distributor Service and the “Gold Key Service” of the Rocky Mountain U.S. Export Assistance Center and by making solid contacts at the U.S. Department of Commerce’s trade and catalogue shows. Other prospective dealers have been located through responses generated from their ongoing, multilingual promotional efforts and through overseas Technical Sales Seminars.

Overseas dealers are required to become experts on all facets of the Hach product line. As a result, the company has established an exhaustive process for training its distributors. Distributors are encouraged to visit the headquarters and the Hach Technical Training Center for hands-on training. In addition, they are required to attend factory-sponsored instrument repair courses presented in the United States and abroad. Since 1996, Hach has held technical sessions for its distributors in Australia, South Asia, Southern Africa, the Pacific Rim countries, the Caribbean, and Latin America.

Recently, the Hach Company expanded its Central Asian presence into Kazakhstan. The business climate and language in this former Soviet economy pose a challenge to American companies. Finding a good local distributor is critical to its success in this market. Hach’s approach was to send staff to the country to identify and build a relationship with a new distributor or sales representative. After a number of years of work, Hach identified a promising distributor candidate. Hach staff sent used equipment to Kazakhstan so that the distributor and its customers could see and feel the products. Now, Hach has applied for U.S. Commerce Department funds to bring its Central Asian distributors to the United States for training. Growth has been slow in the new market, but the company is already beating internal projections. This is in large part due to the fact that its distributor demonstrates the real enthusiasm and excitement that Hach requires of its affiliates.

For more information, contact Paul Goltz, director of international sales and marketing at (800) 227-4224 or the Web site at www.hach.com.

Source: Primary interview with Paul Goltz.

perience can use joint exporting to reduce per unit export costs and develop proactive export strategies which may not be feasible for individual exporters.

The ability to reduce export costs and risks is especially important when considering entry into a new or complex export market. While specific benefits will vary with the nature of the product and the targeted foreign markets, joint venture partners may enjoy the following advantages as a result of their alliance:

- **Market research.** U.S. firms can cooperate to share the costs of foreign market research (including hiring expertise), travel, and overseas activities.

- **Market development.** U.S. firms can reduce the costs of market development activities (for example, overseas trade shows and missions) through joint activities. Firms with complementary products can offer more attractive “full line” packages to prospective buyers. Cost reductions can also be achieved by jointly conducting generic advertising intended to cultivate or increase demand for U.S. products and services.
- **Joint bidding.** U.S. firms can increase sales and profits through joint bidding. As a consortium, the companies can bid on projects that go beyond the capacity of the individual member firms.

- **Joint selling arrangements.** The partners can have joint selling arrangements – use the same overseas representative, agree to sell separate products as a unit, prepare joint catalogs, and allocate among participating partners the sales which result from joint bidding or selling arrangements.
- **Combined sales support.** Joint exporting partners may engage in a variety of activities that will promote or support their combined export sales. These activities might include establishing shared warranty service and training centers, conducting joint trade shows or missions, and joint advertising. In addition, the pooling of credit information may open up new avenues for export financing.

Joint export ventures undertaken by domestic competitors might raise questions under U.S. antitrust laws. Fortunately, any company may apply to the Department of Commerce for an Export Trade Certificate of Review. The certificate provides exporters with antitrust protection with regard to all export activities specified in the certificate.

Funding and Financing Options

This section identifies funding and financing sources for exports of U.S. water and wastewater technologies and services. Development assistance is a primary driver in the water and wastewater sectors of emerging market countries. Multilateral development agencies strongly support, through technical and financial assistance, water supply infrastructure, wastewater treatment systems, and watershed clean-up projects, representing significant market opportunities. This section also considers U.S. investment and export credit programs that are particularly relevant to U.S. technology and services companies, as well as other funding and financing sources.

Multilateral and Bilateral Projects

Bilateral and multilateral development agencies provide the bulk of funding and financing for environmental and infrastructure projects in developing countries (Appendix A contains a summary of ongoing multilateral and bilateral water-related projects). Among the various types of market opportunities that arise from bilateral and multilateral funding sources, the two primary opportunities are equipment sales and technical assistance. To reduce the risk for U.S. companies providing goods and services, payments are typically made in foreign exchange (often U.S. dollars), which makes donor-supported projects particularly attractive to U.S. firms.

Project funds are used to procure the goods, equipment, contract works, and consultant services needed to design and implement these projects, either directly from the funding agency or through loans to the host country government.

Multilateral Development Banks

The multilateral development banks that are central to many U.S. companies' export market strategies include the World Bank, the Asian Development Bank (ADB), the Inter-American Development Bank (IDB), and, to a lesser extent, the North American Development Bank (NADBank), the European Bank for Reconstruction and Development (EBRD), and the African Development Bank (AfDB). The World Bank also manages the Global Environment Facility (GEF), which has emerged as a key funding source for international waters protection programs.

An overview of the key multilateral and bilateral development banks is provided below (contact information for these institutions is listed in Appendix B). Information can be gathered by contacting each individual agency.

The World Bank Group. The World Bank Group is the largest source of international development financing and includes the International Bank for Reconstruction and Development (IBRD), the International Development Agency (IDA), the Multilateral Investment Guarantee Agency (MIGA), and the International Finance Corporation (IFC). The borrower, not the bank, is always responsible for procurement. The Bank provides financing from its loans for the contracts, but the contract itself is between the borrower and the supplier or contractor. The Bank's role is to make sure that the borrower's work is done properly, that the agreed procurement procedures (for example, international competitive bidding) are observed, and that the entire process is conducted with efficiency, fairness, transparency, and impartiality.

Suppliers, contractors, and consultants can learn more about this process by attending a Monthly Business Briefing at World Bank headquarters in Washington, D.C., or reading the *Guide to International Business Opportunities*. The briefings explore strategies for keeping informed about projects and methods for pursuing foreign investment opportunities. The bank issues numerous publications, including *Environment Matters*, which summarizes its environmental operations. The World Bank's environmental projects are summarized in its published portfolio, *Facing the Global Challenge: A Progress Report on the World Bank Global Environment Operations*.

To assess the qualifications of firms and to assist borrowers in establishing a short list, the bank maintains a computerized roster of consulting firms interested in doing business on bank-financed projects, called the Data on Consulting Firms (DACON) system. (There is no similar registration system for manufacturers and other suppliers of goods or contractors for works.)

The United Nations publishes a biweekly digest called *Development Business* which is available by subscription. *Development Business* carries information on business opportunities generated through the World Bank, regional development banks, and other development agencies. *Development Business* is also available by online subscription. More information may be obtained by contacting the World Bank's Development Business Liaison Office (<http://www.devbusiness.com>).

Global Environment Facility (GEF). Projects funded by the GEF are implemented by the World Bank, the United Nations Development Program (UNDP), and the United Nations Environment Program (UNEP). GEF projects to reverse the degradation of international waters help realize the objectives of various regional and international water agreements. The three categories of water projects are: water bodies; integrated land and water projects; and contaminants. From 1991 to 1999, GEF allocated nearly \$360 million to international waters initiatives.

Inter-American Development Bank (IDB). The IDB provides capital for different types of infrastructure projects in 26 Latin American and Caribbean nations. The Bank uses funds to sponsor the development of its member countries by supplementing private investment when private capital is inaccessible. Technical assistance for the preparation, financing, and implementation of development plans and projects is also provided by the IDB. Individuals, firms, and organizations that want to learn how to bid on contracts to provide goods and services for projects financed by the IDB should attend its business seminars. The topics covered in the seminars will help participants develop or expand their participation as suppliers of goods and services in the wide variety of sectors financed by the Bank. These seminars are highly recommended for equipment manufacturers, goods suppliers, work and construction contractors, independent consultants, and consultants from universities, think tanks, and non-governmental organizations (NGOs). The IDB publishes the *IDB Project Magazine*.

Asian Development Bank (ADB). The ADB provides assistance to 33 developing countries in the Asia-Pacific

region, including China, India, and the Philippines. The Bank makes loans and equity investments, and provides technical assistance for the preparation and execution of development projects and programs. The ADB holds Business Opportunities Seminars in different member countries throughout the year (the ADB's North American office is located in Washington, D.C.). The ADB also publishes the *ADB Business Opportunities* on a monthly basis. The online edition of the *ADB Business Opportunities* can be found on the ADB website and is updated weekly.

African Development Bank (AfDB). The AfDB primarily assists the governments or government-owned corporations in member African countries. To better direct financial assistance to environmental sectors, the bank has prepared country environmental profiles. The AfDB's operational program has four main priorities: elimination of poverty, reconstruction and rehabilitation, development of the private sector, and increasing trade and economic integration. The AfDB is also involved in various other sectors, ranging from infrastructure to the economy, including the environment, health care, and demography.

European Bank for Reconstruction and Development (EBRD). The EBRD, based in London, assists countries of Central and Eastern Europe and the former Soviet Union. The financial assistance provided by the EBRD is directed at restructuring and privatizing industries or financing infrastructure in support of these two aims. By mandate, at least 60 percent of EBRD financing must be for private sector operations.

North American Development Bank (NADBank). This bilateral institution, agreed to by the United States and Mexico in connection with the North American Free Trade Agreement (NAFTA), assists U.S. and Mexican border states in addressing environmental problems. NADBank is providing financial assistance for water and wastewater treatment projects along the U.S.-Mexican border.

To participate successfully in multilateral donor-assisted projects, companies must understand the donor's project cycles and bidding procedures. Companies can identify and track project opportunities by subscribing to a donor agency's project notices publication. The typical stages of a project cycle are identification, preparation, appraisal, and implementation. The cycle can last as long as several years. During this long lead time, companies should familiarize themselves with relevant host country institutions and market conditions.

Although companies may contact donor agencies and/or relevant recipient country agencies at any stage of the

project preparation, early involvement is often critical. For example, feasibility studies sometimes conducted in the early phases of the project usually contain valuable technical and contact information. It is also advisable to start forming alliances with local counterparts at the early stages of project development.

United States Agency for International Development (USAID). USAID is the main U.S. bilateral donor agency. It offers economic development and humanitarian assistance (in the form of grants) to advance U.S. economic and political interests overseas. U.S. foreign aid also creates markets abroad for U.S. goods and services by offering a competitive advantage to U.S. suppliers (procuring from U.S. suppliers is mandated by USAID).

Case Study 3.5. Tied Aid Restricts the Export Activities of Aqua-Aerobic Systems, Inc.

Aqua-Aerobic Systems, Inc., of Rockford, Illinois, is a leading manufacturer of wastewater treatment products and systems for industrial and municipal applications. The company has over 100 sales representatives globally, and approximately 130 employees in Rockford.

Aqua-Aerobic Systems has had notable successes in the developing world where municipal wastewater projects received USAID and multilateral development bank funds. Still, it estimates that its market opportunities in this area have been limited by as much as 50 percent due to the phenomenon of tied aid, according to Sharon DeDoncker, the company's vice president of international sales.

Shortly before the Asian financial crisis erupted in 1997, the German government provided bilateral aid for a large municipal wastewater project in Indonesia. Aqua-Aerobic had the necessary vendor qualifications and worked hard to meet the source requirements of the German aid. Its efforts at developing vendor relationships in Germany were not successful, and it ended up losing the project to a German company.

Aqua-Aerobic is writing letters to members of Congress regarding its tied aid concerns. In addition, the company continues to work to develop foreign partnerships that will open up bilaterally-funded projects to it.

For further information, contact Peter Bugg, International Sales Department, at (815) 654-2501 or visit the company's Internet site at www.aqua-aerobic.com.

Source: Primary interview with Sharon DeDoncker.

USAID promotes environmental improvements in host countries by providing technical demonstrations designed to help industries recognize the need for and benefits of cleaner production and cleaner technology. The agency also provides policy and institutional support to aid host country governments in developing environmental management and pollution prevention policies and regulations.

USAID projects are usually bid out of in-country USAID missions and are announced in the *Commerce Business Daily*. Contracts are typically one to five years in duration, with value between \$1 million and \$100 million. Consortia of several companies, usually consulting and engineering firms, have greater chances for success in bidding for USAID projects than individual companies. Companies with local offices that are known to USAID missions find themselves in an advantageous position compared to firms unfamiliar to USAID.

Tied Aid Issues

"Tied aid" is government-to-government assistance—including loans, grants, or concessional (subsidized) financing—that is tied to, or conditioned on, the purchase of goods or services from the donor country and/or a restricted number of countries. Many industrialized countries (Japan, France, Germany, etc.) use tied aid as a subsidy program to facilitate market entry and expansion for their private companies, making such funding unavailable to U.S. companies.

Executives of U.S. environmental exporting companies complain that many foreign governments are spending far more on the promotion of exports of their national companies to developing countries, placing U.S. firms at a distinct disadvantage in the global market.⁴¹ The case study presented below illustrates this issue.

The U.S. policy with respect to tied aid has been to avoid an expensive export subsidy race and to negotiate with other OECD countries to minimize the use of trade-distorting tied aid. Successive rounds of multilateral negotiations led by the Treasury Department and the U.S. Export-Import Bank (Ex-Im Bank) produced the Helsinki Package, an agreement that went into effect in 1992 and established rules prohibiting tied aid for projects that are commercially viable—that is, capable of generating cash flows sufficient to repay standard commercial loans.

41. David R. Berg, *Meeting the Challenge: U.S. Industry Faces the 21st Century: The U.S. Environmental Industry* (Washington, D.C.: U.S. Department of Commerce, Office of Technology Policy, 1998).

While the Helsinki Package agreement has largely eliminated tied aid for commercially viable projects, the U.S. Ex-Im Bank has also created the Tied Aid Capital Projects Fund to match other countries' tied aid offers for certain key projects in order to counter and preempt foreign donor governments' efforts to use aid to gain long-term commercial advantages for their exporters.⁴²

Relevant U.S. Government Investment and Export Credit Programs

USAID Development Credit Authority. The Development Credit Authority (DCA) is a general authority that permits USAID to offer credit assistance for any development purpose of the U.S. Foreign Assistance Act. The DCA is intended to serve as an alternative funding vehicle to assist USAID missions in meeting their specific strategic objectives. DCA is intended for countries and regions where USAID has an active presence. Global climate change activities are the key sector for which USAID intends to use DCA.

The credit assistance is in the form of direct loans and loan guarantees. Loan terms are related to the needs of each project but will not exceed 20 years. Loan guarantees are used only where lenders engage in true risk sharing with USAID and will cover no more than 50 percent of the lender's risk of loss. For projects to be eligible, they must have positive financial rates of return so that the loans can be repaid. Loan amounts are in the range of \$2 million to \$20 million, depending on the project. The maximum loan amount is \$100 million. These loans and loan guarantees can have a substantial effect on water and wastewater investment projects, as evidenced by the Aqua-Chem case study presented below.

Export-Import Bank of the United States (Ex-Im Bank). The U.S. Export-Import Bank is an agency of the U.S. government that provides export credit support either to U.S. exporters on a short-term basis or to foreign purchasers on a longer term basis (2-10 years). Through loan guarantees and insurance, the agency fosters exports by making working capital available to U.S. exporters. Alternatively, through similar mechanisms plus the extension of direct loans (and, on occasion, grants), the Ex-Im Bank provides credit at attractive interest rates to foreign buyers to encourage their purchase of U.S. goods and services. The Ex-Im Bank insures a wide variety of U.S. environmental exports, giving priority to small-

42. For more information, visit the Ex-Im Bank's Web site at www.exim.gov or contact the Ex-Im Bank's Tied Aid Coordinator at (202) 565-3814.

Case Study 3.6. Export-Import Bank Loan Guarantee Supports Aqua-Chem's Sale of Desalination Equipment to the Caribbean

Aqua-Chem, Inc.'s Water Technologies Division manufactures boilers and seawater desalination equipment. Headquartered in Milwaukee, Wisc., the division has developed a worldwide reputation as a supplier of industrial water equipment. It currently employs 1,300 people in the United States.

Aqua-Chem sold a complete desalination system to the Dutch colony of Aruba in 1998. This \$8 million system provides 11.2 million gallons per day of desalted water to the Caribbean island. Used for both industrial applications and for potable water, the water generated by the desalination plant has helped the island keep up with the tourism-driven demand.

Aqua-Chem had provided desalination units to Aruba in the past and the Water and Electricity Board was pleased with its products. However, the utility had recently gone through a partial privatization and was particularly sensitive about capital costs. In order for the utility to purchase the more expensive but higher quality Aqua-Chem units, the company had to structure a particularly attractive financial package.

Aqua-Chem turned to the Export-Import Bank for assistance. The Ex-Im Bank facilitated the sale by providing a loan guarantee to the Water and Electricity Board for this project. Ron Thimm, treasurer, stated that "without the Ex-Im Bank money, Aqua-Chem would very likely have lost the job to a foreign competitor."

Aqua-Chem used a banker to structure the financing and to complete the Ex-Im Bank application. Mr. Thimm highly recommends the use of a banker who understands both Ex-Im Bank's financial assistance tools and other financing sources. He also stressed the importance of educating sales staff about the financing solutions and countries where Ex-Im funds are available.

For more information, contact Ron Thimm, treasurer, (414) 577-2845 or visit the company's Web site at www.aqua-chem.com.

business transactions and the expansion of the overseas presence of the U.S. environmental goods and services industry. The Ex-Im Bank does not compete with commercial lenders, but assumes the risks they cannot accept.

The Bank has designed a special Environmental Exports Program that will provide enhanced levels of support for a broad range of environmental exports. The

program demonstrates the Bank's resolve to reach out to small and large exporters of environmental products and services. In 1997, the Environmental Exports Program approved 47 transactions for a total export value of \$1.9 billion.⁴³ The major features of the program are:

- A short-term Environmental Export Insurance Policy provides enhanced short-term multi-buyer and single-buyer insurance coverage for small environmental exporters. The program features policies that deliver 95 percent commercial risk coverage and 100 percent political risk (risk due to unexpected political events in the host country) coverage with no deductible.
- Enhanced medium- and long-term support for environmental projects, products, and services. These enhancements, which are reflected in the Ex-Im Bank's loan and guarantee programs, include: local cost coverage equal to 15 percent of the U.S. contract price, capitalization of interest during construction, and maximum allowable repayment terms permissible under OECD guidelines.

Overseas Private Investment Corporation (OPIC).

OPIC, a U.S. government agency, helps U.S. businesses of all sizes invest and compete in 140 emerging markets and developing nations worldwide. OPIC finances medium- to long-term investment projects through loan guarantees and direct loans. Direct loans are geared for small businesses or cooperatives and usually range between \$2 million and \$10 million. Loan guarantees range between \$10 million and \$200 million. OPIC protects U.S. business activities in emerging markets through its Investment Insurance Programs against currency inconvertibility, expropriation (loss of investment due to expropriation, nationalization, or confiscation by a foreign government), and political instability. The insurance programs also can be used to cover expanding investments. OPIC also offers the Small Contractor's Guarantee Program, which assists small business construction and service contractors. However, OPIC does not provide export financing.

There are also several funds operating under the aegis of OPIC that support U.S. environmental exports and investment overseas (see the section on commercial financing sources, below).

U.S. Small Business Administration (SBA). The SBA has an Export Working Capital Program that guarantees

up to \$750,000 of either short- or long-term loans to help small businesses increase their export sales of products or services. This program is designed to assist small businesses requiring capital to expand sales or manufacturing for international markets, as well as meet their working capital needs. Loan proceeds may not be used to establish operations overseas.

Commercial Financing Sources

Private Export Funding Corporation (PEFCO).

PEFCO is a consortium of private lenders which acts as a supplemental lender to traditional export financing sources. It works with the Ex-Im Bank by using private capital to finance U.S. exports. PEFCO makes loans of up to \$225 million to public and private borrowers located outside of the United States who require medium- and/or long-term financing on purchases of U.S. goods and services through traditional lenders or suppliers. In all cases, the loans made by PEFCO must be covered by the comprehensive guarantee of repayment of principal and interest by the Ex-Im Bank. The loan requests must come through a commercial bank.

Global Environment Fund Family of Funds.

This group of funds specializes in high-growth markets for environmental technologies, products, and services. The Global Environment Fund is a partnership that invests up to \$4 million per venture in public and private environmental companies around the world. Global Environment Finance Partners invests in advanced-stage private firms for investments ranging from \$500,000 to \$2 million. The Global Environment Emerging Markets Funds (GEEMF I and II) are capitalized by OPIC and focus on environmental infrastructure in developing countries where OPIC operates.

Allied Capital International Small Business Fund.

This is a \$20 million equity fund that invests in OPIC-designated countries and is managed by the Allied Capital Corporation. Eligible companies are small U.S. businesses seeking risk capital to expand overseas. The preferred investment size is \$2 million to \$5 million. One of the sectors targeted by the Fund is environmental services.

Aqua International Partners Environmental Fund.

Aqua International Partners, a \$232 million investment fund, makes private equity investments in companies providing water and water-related products or services to emerging market economies. Aqua invests in operating and special purpose companies that are devoted to water

43. *Financing Environmental Exports: A Guide to the Fundamentals and Sources*, U.S. Department of Commerce, International Trade Administration, 1998.

and wastewater treatment operations (either being privatized or newly formed); manufacturing equipment or products (pipes, pumps, meters, filters, etc.) for commercial, industrial, and residential water users; and other related activities or services.

U.S. Commercial Banks. U.S. commercial banks provide the bulk of trade and investment finance. In addition, various types of private and public infrastructure funds can be used to support technology exports. The U.S. Department of Commerce maintains a national clearinghouse of private and public financial institutions that offer trade finance. Also, the Office of Finance within the Department of Commerce's International Trade Administration has developed a Web-based export finance matching service. This service is designed to match U.S. exporters with sources of export financing or risk mitigation. The site also provides links to U.S. commercial financing sources by state.

Local Commercial Banks. Local financial institutions have an important role to play in financing small (under

\$1 million) environmental investments, particularly in the industrial sector. Credit is generally tight in developing countries, making current conditions in local capital markets a significant factor in financing energy efficiency investments. Chile is a positive example of a fairly well-developed local capital market, including a long-term bond market. However, in most other developing countries, capital markets are immature, and U.S. firms often find it too difficult and expensive to borrow money locally, unless local financial institutions act as intermediaries for external financing sources such as multilateral development banks.

Self-Financing Mechanisms. Very few U.S. water and wastewater companies have set up their own financing arms to complement their technology exports. However, the larger, total solution-oriented companies can often successfully create their own entities for identifying funding sources and structuring debt and equity financing. The case study below highlights the success of Lemna International in setting up a financing arm.

Case Study 3.7. Lemna: Finding Funds for International Clients

Lemna International, Inc., of Minneapolis, Minn., is recognized worldwide as a supplier of innovative wastewater treatment systems. Lemna offers complete treatment plant designs and equipment for municipal and industrial applications globally, and has completed more than 100 facilities. About 60 of these are in the United States, with the remainder located in developing countries, including Turkey, Poland, and Slovakia. Lemna International's sister company, Lemna Technologies, works with municipalities of fewer than 100,000 people. Lemna also provides its technologies to industries, including food processing plants, dairies, wineries, packaging production facilities, rendering plants, pig farms, and many others. In Poland, Lemna has worked with more than 30 municipalities, from small rural communities to medium-sized cities of 100,000 to 200,000 inhabitants.

When Lemna found that obtaining funds to build water and wastewater infrastructure was a major problem for many of its clients, the company designed an innovative strategy to help its clients secure needed project funds. The Lemna Infrastructure Financing Enterprise (LIFE) was set up to identify possible funding sources and help clients arrange appropriate financing terms. LIFE staff help Lemna International's clients determine which financing structure will best meet their needs, and then assist them

in securing all or part of the funds. LIFE works with debt, equity, and lease-back arrangements, and is experienced in working with private and institutional investors, private lenders, and export credit agencies, including the U.S. Export-Import Bank.

LIFE structured a \$25 million loan package for the design and construction of a sewage system and wastewater treatment plant for a Turkish municipality of 400,000 people. The loan package included funds from Ex-Im and two international banks. The first phase of this project has been constructed, and LIFE is beginning work on financing for Phase II, also for \$25 million. LIFE is nearing completion of a debt and equity package for a wastewater treatment plant in China, to be built through a joint venture that includes Lemna International. The total financing for this project will be about \$120 million. Other current LIFE projects range in size from wastewater treatment projects in Poland valued at less than \$6 million to a \$36 million water supply project in Romania and a \$50 million water supply expansion project in sub-Saharan Africa.

For more information, contact Poldi Gerard, vice president of marketing, at pgerard@lemna.com or (612) 253-2000, or visit Lemna's Web site at www.lemna.com.

Source: Primary interview with Poldi Gerald.

Chapter 4

Best Prospects in Water and Wastewater Treatment

The countries that represent best prospects for U.S. exporters of water and wastewater equipment and services are determined by a number of factors, including, but not limited to, the:

- Overall size of the water and wastewater market in the country;
- Openness of that market to imports (partly reflected in the share of imports in the total market);
- Market's growth rate; and
- Historic U.S. position in the market and the U.S. import market share.

This chapter contains market profiles of 12 countries that fit several of these criteria. The profiled countries are Australia, Brazil, China, Egypt, India, Japan, South Korea, Mexico, Saudi Arabia, Spain, Taiwan, and the United Kingdom, representing a mix of developed and developing countries.

Each of the country profiles provides general statistical data,⁴⁴ a market overview, and discussions of the

regulatory and institutional framework for the water sector, the status of privatization of the water supply and sewerage infrastructure, U.S. market share and competition, and market opportunities.

Brazil, China, India, Japan, South Korea, Mexico, Spain, Taiwan, and the United Kingdom all have water and wastewater markets that exceed \$1 billion in size. Such emerging markets as China, India, South Korea, Taiwan, Mexico, and Brazil have enormous potential due to the extent of unmet water supply and sewerage needs. These countries' growth rates usually exceed 10 percent per year. Japan, the United Kingdom, and Spain are mature markets with slower growth, but their sheer size and favorable business climate make them worth exporters' consideration. Australia is another mature market of smaller size than Japan, the United Kingdom, and Spain, but it is a market that favors U.S. firms. Egypt and Saudi Arabia are niche markets for U.S. exporters. Egypt is an exclusively donor-driven market, where U.S. foreign aid gives a significant advantage to American companies. Saudi Arabia is a highly specialized market with a focus

44. Unless otherwise noted, the general statistical data were taken from *Global Water Supply and Sanitation Assessment 2000*, World Health Organization, 2000, with the exception of the GDP growth data that were taken from *World Development Report*, World Bank, 2000.

45. Includes Hong Kong.

46. The numbers cover the desalination market only.

Table 4.1. Principal Water and Wastewater Market Characteristics in Selected Countries

<i>Country</i>	<i>Total Market Size (millions of dollars)</i>	<i>Annual Growth (percent)</i>	<i>Percent of Total Market from Imports</i>	<i>U.S. Import Market Share (percent)</i>
Australia	603 (1999)	7	70	55
Brazil	1,700 (1998)	n.a.	20	35
China ²	5,336 (1999)	25-35	35	12
Egypt	856 (1998)	10	90	35
India	1,180 (2000)	15	40	25
Japan	6,000 (1996)	5-8	n.a.	n.a.
S. Korea	3,400 (2000)	n.a.	40	20
Mexico	2,390 (2000)	10	80	70
Saudi Arabia ⁴⁶	357 (1998)	5	85	16
Spain	4,000 (1998)	n.a.	n.a.	n.a.
Taiwan	1,900 (1999)	n.a.	75	28
United Kingdom	4,000 (2000)	4	55	25

n.a. = not available

Sources: Various—see references in individual country profiles.

on desalination technology, where the U.S. also has a good strategic position.

Table 4.1 presents a summary of the estimates of the principal market indicators for the profiled countries.

Table 4.2 presents data on the value of U.S. water and wastewater technology exports to 32 countries. These

data represent exports of potable water treatment equipment, water and wastewater monitoring and analysis equipment, and wastewater management equipment.⁴⁷ The countries that are profiled here are indicated in gray.

47. These data were obtained by analyzing the appropriate 10-digit HTS codes.

Table 4.2. U.S. Exports of Key Categories of Water and Wastewater Equipment, 1999 (thousands of U.S. dollars)

<i>Rank</i>	<i>Country</i>	<i>Potable Water Treatment</i>	<i>Monitoring and Analysis</i>	<i>Wastewater Management</i>	<i>Total</i>
1	Mexico	173,533	2,399,198	1,710,963	4,283,694
2	Canada	68,955	2,789,464	1,014,083	3,872,502
3	Japan	232,961	1,023,557	143,317	1,399,835
4	United Kingdom	78,869	664,966	119,326	863,161
5	Germany	78,946	633,498	92,968	805,412
6	South Korea	178,534	384,983	68,827	632,344
7	Taiwan	174,857	354,546	62,139	591,542
8	Singapore	141,393	317,748	33,108	492,249
9	China (w/Hong Kong)	38,284	337,081	92,386	467,751
10	Netherlands	94,100	332,198	30,681	456,979
11	France	9,174	320,599	115,835	445,608
12	Italy	40,966	245,110	4,773	290,849
13	Belgium	735	119,342	51,064	171,141
14	Malaysia	40,968	107,197	12,800	160,965
15	Australia	4,919	87,109	48,568	140,596
16	Brazil	4,727	92,290	15,809	112,826
17	Israel	46,572	55,127	5,244	106,943
18	Philippines	54,655	32,289	1,478	88,422
19	Spain	805	49,336	24,674	74,815
20	Thailand	0	64,228	4,094	68,322
21	Aruba	58,662	0	0	58,662
22	Saudi Arabia	559	25,188	31,827	57,574
23	Russia	0	23,012	24,617	47,629
24	Ireland	0	29,074	11,689	40,763
25	Switzerland	0	33,913	3,353	37,266
26	Venezuela	9,609	14,475	12,593	36,677
27	United Arab Emirates	151	23,260	3,954	27,365
28	Sweden	0	24,382	786	25,168
29	India	0	14,879	6,888	21,767
30	Argentina	2,961	10,986	5,944	19,891
31	Dominican Republic	173	11,691	1,645	13,509
32	Egypt	1,057	930	9,360	11,347
33	Turkey	448	4,922	5,197	10,567
34	Colombia	2,267	2,215	5,133	9,615
35	Austria	5,149	1,997	0	7,146

Source: U.S. International Trade Commission, Harmonized Tariff Schedule.

Australia

Population: 19 million (2000)
Urban population: 84 percent (2000)
GNP per capita: \$20,640 (1999)
GDP average annual growth rate: 3.8 percent (1990–1998)
Water supply coverage (urban/rural): 100 percent/
100 percent (2000)
Sanitation coverage (urban/rural): 100 percent/
100 percent (2000)

Market Overview

The sewerage systems in most of Australia’s major cities are old and overloaded. Infiltration of rainwater and overflows of sewage are frequent problems. Large investments are needed to increase sewer capacity and improve their condition, as well as to improve the quality of treatment. In addition, municipalities are turning to the practice of recycling wastewater in order to alleviate the pollution load of the country’s rivers and coastal waters. Water supply problems in Australia are not as urgent as wastewater ones, with nearly all the population connected to centralized water supply, most of which is treated to some degree, if only by disinfection.

Water and wastewater treatment are the largest segments of environmental business in Australia, representing 67 percent of the total environmental market. The total market for water and wastewater equipment was estimated at \$603 million in 1999, with 70 percent of the demand satisfied by imported equipment. Investment in water supply infrastructure was roughly \$232 million in 1999, compared to \$374 million for municipal wastewater treatment plants. The distribution of these invest-

ments by state and territory is shown in Table 4.3. The market is growing at about 7 percent a year, due mainly to the water and sewerage infrastructure rehabilitation and expansion programs.⁴⁸

The industrial wastewater treatment market is much smaller but has been growing recently as the regulatory requirements for pretreating industrial effluents become more stringent. The Australian Water and Wastewater Association estimates that the Australian industry spends about \$59 million per year for on-site effluent pretreatment.⁴⁹

Regulatory and Institutional Framework

Australia’s federal government has limited environmental responsibilities, with most functions administered by states and territories. The Department of Primary Industries and Energy oversees water resource issues. The National Environment Protection Council and the Environmental Protection Agency are responsible for coordinating environmental management programs at the federal and state levels. The Council oversees the implementation of environmental regulations at the federal level. However, pollution licenses are issued and enforced by state authorities. In some states (for example, Queensland), the licensing and enforcement have been delegated to the local councils. States have recently undertaken initiatives aimed at using guidelines and codes of practice for certain polluting industries, as part of the general trend away from a rigid command-and-control system toward industrial self-monitoring and self-regulation.

State governments are responsible for water supply and wastewater treatment in Australia, although day-to-day operational management is carried out at the local level.

Table 4.3. Investment in Water and Wastewater Treatment Plants in Australia, 1999 (millions of U.S. dollars)

State/Territory	Investment Amount
New South Wales	203.4
Victoria	155.5
Queensland	93.5
South Australia	56.2
Western Australia	67.8
Tasmania	10.6
Australian Capital Territory	18.5
Northern Territory	0.7
Total	606.2

Source: *The Water and Wastewater Market in Australia*, Canada, Department of Foreign Affairs and International Trade (Ottawa, 1999).

Privatization

Australian state governments are starting the process of restructuring and reforming public utilities by setting up state-owned corporations. The move is supposed to promote greater efficiency through increased competition. To date, almost all Australian public water authorities have been incorporated, and most states are looking toward eventual privatization, primarily due to the lack of investment funds. Presently, although state-owned utilities are still the main purchasers of wastewater treatment equipment, some of them have already been opened

48. *The Water and Wastewater Market in Australia*, Canada, Department of Foreign Affairs and International Trade (Ottawa, 1999).

49. Ibid.

to private participation via management contracts. New sewage treatment plants are usually privatized under BOO contracts.

Trade and Investment Policy

No trade restrictions or other non-tariff barriers exist for imported water and wastewater equipment. The general import tariff rate varies from 0 to 5 percent, depending on whether or not local manufacturers exist for the same product. Certain state-of-the-art capital equipment may be imported duty free for specific projects.

There are no tight controls that govern imported water and wastewater equipment. Each technology or type of equipment is evaluated on its own merits. Details of applicable state-level technology requirements may be obtained from the environmental departments or relevant industry associations.

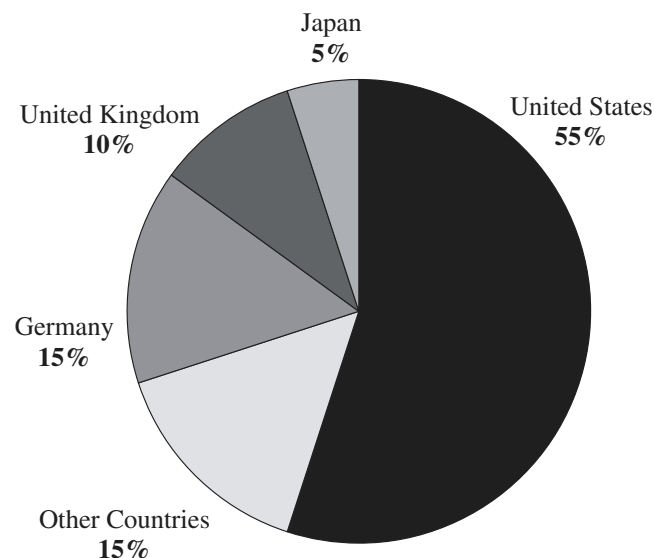
U.S. Market Share and Competition

Australia has developed world-class expertise in some areas of wastewater treatment, and a number of local environmental firms sell competitive sewage treatment process equipment. The majority of pipes and fittings are also manufactured locally. The industry is dominated by small and medium-sized companies with sales less than \$1 million. The principal Australian manufacturers in this market include Acron Noble Pty. Ltd. (biological wastewater treatment systems), Australian Ultraviolet Services (ultraviolet disinfection equipment), Sepa Wastewater Treatment (turnkey treatment plants), Tubemakers of Australia (pipes and fittings), Warman International Ltd. (pumps), etc.

Domestic sales, however, have historically been hampered by the unwillingness of the water utilities to trust the local industry or to support local innovations. In addition, the local industry sometimes lacks investment capital to fund research and development projects and to commercialize their products.

The United States dominates the import market for wastewater treatment equipment with a 55 percent market share, followed by Germany, Britain, and Japan (see Figure 4.1). Wastewater equipment is also imported from France, Sweden, and Italy. The major overseas players include French companies ONDEO and Vivendi and the British company Thames Water. ONDEO is basing its Asia/Pacific wastewater research program in Sydney, creating a great potential for future exports. The success of these firms can be partly attributed to Australia's historical choice of European over U.S.-designed sewerage systems. Another obstacle for U.S. suppliers is their reluctance to meet Australian quality assurance standards.

Figure 4.1. Import Market Shares for Wastewater Treatment Equipment in Australia



Source: U.S. and Foreign Commercial Service and U.S. Department of State, *Industry Sector Analysis; Australia: Wastewater Treatment Equipment* (Washington, D.C.: 1998).

Many large wastewater treatment BOO projects have been awarded recently to French and British companies in consortia with Australian firms. A consortium led by Vivendi that includes Thames Water has recently won a \$1 billion 15-year operations and management contract for Adelaide's water and wastewater utility. U.S. companies have been largely absent from these projects. Nonetheless, U.S. water and wastewater equipment suppliers still have opportunities to sell to local companies bidding on such concessions.

Market Opportunities

The biggest opportunities exist in wastewater treatment systems. Some of the major projects currently underway include:

- Upgrade of the Woodman Point wastewater treatment plant in Western Australia (\$79 million)
- Expansion of the Perth sewerage network, Western Australia (\$174 million)
- Construction of a sewerage tunnel and a sludge handling plant in Camellia, New South Wales (\$178 million)
- The Hunter Sewerage Project, New South Wales (\$205 million)
- Upgrade of the wastewater treatment plant at Cronulla, New South Wales (\$60 million)

- Expansion of the Picton sewerage network, New South Wales (\$36 million)
- The Northwestern Sewerage Project, Victoria (\$152 million)
- Upgrade of the Bolivar wastewater treatment plant, South Australia (\$66 million)

The largest water supply infrastructure projects are the upgrade of 30 inland water treatment plants in New South Wales (\$180 million), 10 water treatment plants in South Australia (\$54 million), and the Gladstone water supply expansion project in Queensland (\$114 million).

Best sales prospects include biofiltration systems, sludge presses and stabilizers, oxidation systems for industrial wastewater treatment, filtration equipment, and membrane technologies for water recycling. Given the strength of local manufacturers, fewer opportunities exist for pumping equipment.

Some industrial wastewater treatment opportunities exist at gold and copper mines, wool scour mills, steel mills, pulp and paper mills, breweries, petrochemical plants, chemical and pharmaceutical plants, abattoirs, and food processing facilities.

Brazil

Population: 170 million (2000)

Urban population: 81 percent (2000)

GNP per capita: \$4,420 (1999)

GDP average annual growth rate: 3.2 percent (1990–1998)

Water supply coverage (urban/rural): 95 percent/
45 percent (2000)

Sanitation coverage (urban/rural): 85 percent/
45 percent (2000)

Market Overview

Brazil's water supply and sanitation sector is experiencing a wide range of technical, operational, financial, and other problems. The water supply network is expanding slowly and cannot cope with the rapid population growth. Up to 50 percent of water loss occurs in the distribution system. Municipal wastewater treatment has historically received even less investment than water supply. Only 20 percent of the wastewater collected is treated. Large quantities of untreated sewage are discharged into open waters, resulting in a serious public health hazard, particularly in such states as São Paulo, Minas Gerais, and Rio de Janeiro. There are also stark differences in the extent and quality of water supply and sanitation services between the richer south and southeast regions of the country (about 60 percent sewerage coverage) and

the poorer north and northeast (less than 5 percent coverage).⁵⁰

In metropolitan centers such as Rio de Janeiro and São Paulo, industrial effluents represent around 30 percent of the organic load in the total wastewater discharges. About 20 percent of the industrial facilities are responsible for almost 80 percent of the industrial effluent load. Almost all the large polluters have signed agreements with regulatory agencies that defined their compliance plans.

Investment needs are estimated at \$33 billion through 2010 to overcome existing gaps in water supply and sewerage coverage, as well as to respond to the growing demand for these services.⁵¹ The water and wastewater technologies market was estimated at \$1.7 billion in 1998.⁵² The demand for consulting services will likely be around \$100 million per year through 2004.⁵³

Regulatory and Institutional Framework

The 1997 Water Law introduced the river basin management approach in Brazil, with multi-stakeholder water basin committees being responsible for long-term water resources planning and charging water use and wastewater discharge fees (established in a 2000 regulation). The federal agency responsible for the regulation and overall supervision of the water resources sector is the Division of Sanitation of the Secretariat of Urban Policy of the Ministry of Planning and Budget. The policy stipulates that water supply and sanitation services can be provided by state-wide water and wastewater companies (under current concessions), municipal public utilities, or private companies. In 2000, a new law created the National Water Agency, which will coordinate the national water policy and the privatization of state-owned water companies.

The 1990 National Environmental Policy Act defined water quality standards and a national discharge permit system that are based on nine water use categories (for example, domestic consumption, recreation, irrigation, etc.). The permit system is administered by the National Environmental Council. States have the authority to make their regulations more stringent than the federal standards. For example, the environmental agencies in the states of Rio de Janeiro and São Paulo have adopted effluent stan-

50. "Brazil: Water and Wastewater Concession Opportunities," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

51. *Ibid.*

52. *Brazil Environmental Technologies Market*, Latin America Business Development Mission, U.S. Department of Commerce, 2000.

53. *Brazilian Wastewater Industry Forecast 2000*, InfoAmericas (<http://infoamericas.com>).

dards that require secondary treatment of wastewater discharges. Recent regulations require effluent self-monitoring and reporting from municipal sewage treatment plants and several types of industry. The 1998 Environmental Law contributed significantly to the improvement of environmental enforcement in the country by raising sanctions for environmental violations.

Privatization

In the 1990s, privatization of state-owned enterprises began to be recognized as a tool for economic change, as the government strove to reduce subsidies to unprofitable companies. Public service monopolies started to open up to competition and impartial regulation. Ambitious privatization programs have been undertaken in the telecommunications, power, and, to a lesser extent, water and sanitation sectors.

According to the Law on Concessions, the authority to issue water and wastewater concessions rests at the municipal level. However, the state authorities continue to oversee regional distribution networks and utilities that service more than one municipality. In fact, state governments are better positioned than municipalities to design concessions and provide financing guarantees for projects.

Resources are available through the Brazilian Economic Development Bank to finance privatization studies and projects, both at the state and municipal levels. The Bank is more inclined to support post-privatization investments by operators than finance the privatization process itself.

The private sector participation models currently used in Brazil's water sector include service contracts (most commonly used), full concessions (used mostly in smaller cities), BOT schemes (in the states of São Paulo and Minas Gerais), and joint ownership arrangements (so far, the only example of this scheme is the Parana State Water Company).

The majority of private participation projects (16) are taking place in the state of São Paulo, most under the BOT scheme, with six of them involving investments of over \$10 million. The largest project in the state is the \$124 million concession that has been granted to Aguas de Limeira, a joint venture between the French conglomerate ONDEO and Compahnia Brasileira de Projectos e Obras, a Brazilian civil construction firm. The state of Rio de Janeiro uses only the full concession model, and the four largest mixed water/wastewater concessions in the state are worth almost \$400 million in investments.⁵⁴

54. "Brazil: Water and Wastewater Concession Opportunities," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

Another breakthrough for the private sector occurred in 1998, when Vivendi acquired 30 percent of the shares of Sanepar, which serves seven million people in the state of Parana.

At the same time, water utility privatization faces opposition from some political groups and unions. For example, the privatization of CEDAE (the Rio de Janeiro state public company), the second-largest water company in Brazil, has been canceled due to political controversy and legal actions.

Trade and Investment Policy

Brazil is a member of Mercosur—a regional free trade agreement that also includes Argentina, Paraguay, and Uruguay. However, Brazil's industry remains protected from imports from non-Mercosur countries. Tariffs for environmental equipment are still high (even though they have dropped dramatically over the last decade) and average 19 percent.

Despite the fact that Brazil must comply with World Trade Organization (WTO) regulations requiring equal treatment of foreign and domestic companies, there is a non-official "buy Brazilian" policy for government procurement. Foreign companies that have production facilities in Brazil are usually chosen over those that have not committed to investment in the country. Brazilian law requires foreign bidders to be associated with a local firm.

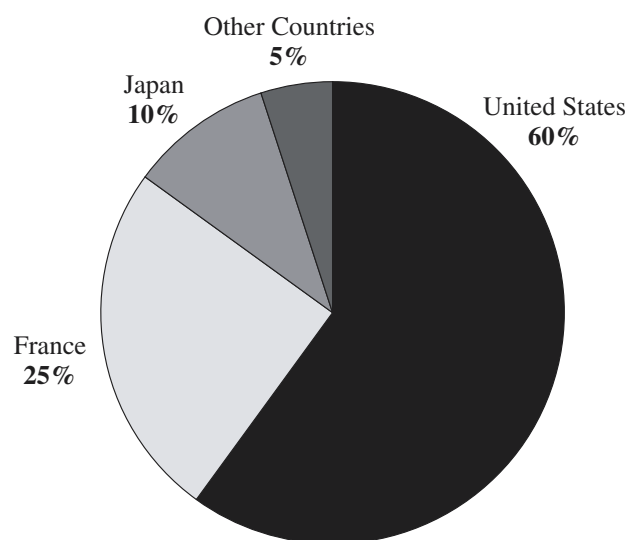
U.S. Market Share and Competition

Over 80 percent of the water supply and sanitation equipment in Brazil is produced by Brazilian manufacturers, although roughly half of them are engaged in some form of technology agreement with foreign partners. For instance, the market for pipes and fittings is dominated by the French company Pont-à-Mousson, which operates under the name Barbara in Brazil.⁵⁵ Filsan and its subsidiaries, Enfil and Aquamec, are other examples of Brazilian water and wastewater equipment suppliers having a significant market share. These companies have operated for over 30 years and have established solid relationships with most municipal and state clients. Partnering with a Brazilian company is almost imperative for foreign exporters in this market.

U.S. exports represent about 35 percent of the import market for municipal water supply and wastewater treatment equipment, followed by France, Germany, and Sweden. In the industrial wastewater treatment market segment, the U.S. holds a 60 percent import market share, followed by France and Japan (see Figure 4.2). The best

55. Ibid.

Figure 4.2. Import Market Shares for Industrial Wastewater Treatment Equipment in Brazil



Source: Canada, Department of Foreign Affairs and International Trade, *The Water and Wastewater Market in Brazil* (Ottawa, 1999).

established European water companies in Brazil are the French groups Vivendi and ONDEO, Britain's Thames Water, and Aguas de Portugal.

Market Opportunities

All around Brazil, significant potential opportunities abound for investors and suppliers of water and wastewater equipment and services to participate in the privatization program. A strong market growth can be expected for BOT projects in the construction and operation of wastewater treatment plants, particularly in cities with over 100,000 inhabitants.

About 80 percent of the funds allocated for improvements of water and wastewater systems in low-income areas is distributed through Brazil's Social Action and Sanitation Program. Between 1995 and 1998, the program spent \$440 million on water supply improvements and \$930 million on wastewater treatment projects.

Other opportunities come from large projects implemented with support from multilateral development banks, including the IDB's Tiete River Cleanup Project (\$400 million), the Federal District Basic Sanitation Program (\$260 million), the Guaíba Watershed Environmental Management Program (\$221 million), as well as the World Bank's Bahia Water Resources Management project (\$51 million), and São Paulo Water Quality and Pollution Control Program (\$245 million).

Private industry, particularly textile, petrochemical, and pulp and paper industries, pressured by stricter en-

Table 4.4. Brazilian Wastewater Equipment Demand Forecast, 2001–2004 (millions of U.S. dollars)

Equipment Type	2001	2002	2003	2004
Wastewater treatment equipment	200	270	350	450
Pipes	450	500	520	550
Hydrometers	98	123	131	135
Pipe cleaning equipment	15	17	21	23
Valves	15	20	26	33
Pumps	45	52	58	67
Other	32	38	44	52
Total	855	1,020	1,050	1,310

Source: *Brazilian Wastewater Industry Forecast 2000*, InfoAmericas (<http://infoamericas.com>).

vironmental laws, will also invest more in effluent treatment equipment.

Wastewater treatment accounted for 41 percent of investments in this sector in 2000, water infrastructure improvements for 38 percent, sewerage system upgrades for 15 percent, and engineering and consulting services for 6 percent.⁵⁶ Table 4.4 presents projected opportunities for sales of different types of wastewater equipment.

Despite the strength of local manufacturers of pipes, valves, pumps, and septic tanks, there are still technology gaps in Brazil's water and wastewater market that need to be filled by imports. These include hydrometers, leak detection equipment, and wastewater treatment equipment and chemicals, as well as automation software.

People's Republic of China

Population: 1.278 billion (2000)

Urban population: 32 percent (2000)

GNP per capita: \$780 (1999)

GDP average annual growth rate: 11.2 percent (1990–1998)

Water supply coverage (urban/rural): 94 percent/66 percent (2000)

Sanitation coverage (urban/rural): 68 percent/24 percent (2000)

This market profile covers both mainland China and Hong Kong. On July 1, 1997, Hong Kong reverted to

56. *The Water and Wastewater Market in Brazil*, Canada, Department of Foreign Affairs and International Trade, 1999.

Chinese sovereignty under the concept of “one country, two systems” and, as a Special Administrative Region, is run with a high degree of autonomy.

Market Overview

Water supply and wastewater treatment are presently top priorities of China’s environmental protection and infrastructure development policies. Water shortages, caused by uneven distribution, inefficient use, and contamination of water resources, affect approximately 400 cities in China. Thirty cities, including Beijing, are expected to face long-term water shortages.

Ambient water quality has deteriorated dramatically due to the phenomenal growth in industrial development over the last two decades, lack of enforcement of environmental standards, poor treatment of industrial effluents, and inadequate investments in infrastructure. Presently, in urban areas, less than 20 percent of wastewater is treated, and close to 90 percent of urban drinking water sources are polluted to some degree.⁵⁷ China has committed to continue its efforts to improve water supply and sanitation. The government has set a target of a 40 percent treatment rate for sewage by 2010. This will require approximately \$24 to \$36 billion, excluding operating costs.⁵⁸

In Hong Kong, water pollution from sewage and industrial wastewater discharges is the most visible environmental concern. Roughly 10 percent of wastewater receives biological treatment before discharge, 40 percent receives partial treatment, and the remaining 50 percent is discharged into the sea without any treatment.⁵⁹

Under China’s Ninth Five-Year Plan (1996–2000), the clean-up of three lakes (Tai, Chao, and Dianchi) and three rivers (Huai, Hai, and Liao) were top priorities of the state economic development policy. The clean-up effort achieved some positive results. However, the construction of 131 new municipal wastewater treatment plants has yet to begin, and 535 industrial plants have to install effluent treatment systems.⁶⁰

China’s water and wastewater technologies market is enormous—over \$5.3 billion in 1999. Even though most of the market demand is covered by local production, the import market alone amounts, according to the U.S. Commercial Service, to almost \$2 billion a year.

57. *The Environmental Industries Market in China*, Canada, Department of Foreign Affairs and International Trade, 2001.

58. *China Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 2002.

59. *The Environmental Industries Market in Hong Kong*, Canada, Department of Foreign Affairs and International Trade, 2001.

60. *The Environmental Industries Market in China*, Canada, Department of Foreign Affairs and International Trade, 2001.

Table 4.5. Estimated Size of the Water and Wastewater Technologies Market in China, 1999 (millions of U.S. dollars)

	<i>Local Production</i>	<i>Imports</i>	<i>Total Market Size</i>	<i>Growth Rate, 2000–2001 (percent)</i>
Water treatment and supply	1,506	646	2,152	35%
Wastewater treatment	1,911	1,273	3,184	25%
Total	3,417	1,919	5,336	

Sources: China: “Water Treatment and Supply” and “China: Wastewater Treatment Technologies,” *Industry Sector Analyses*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

The size of the market for water and wastewater technologies is enormous and the scope of the country’s water and wastewater projects is gargantuan. For example, the Chinese government has committed to a plan to transfer water to the parched north from the wet southern regions. In 2001, the PRC government has committed to a schedule to make this South-North Water Transfer project a reality. Three transfer channels will be constructed, the first two in the east and in the center. The eastern route will be completed by 2010 with a total cost of \$7.25 billion. Phase I of the construction of the central route will be completed by 2010. The total cost of this effort will be approximately \$10 billion. The western route is still in the early planning phases. The government has stressed that this project is to be linked with enhanced efforts to increase water use efficiency, prevent pollution, and charge appropriate water prices.⁶¹

Regulatory and Institutional Framework

China’s State Environmental Protection Agency is responsible for drafting and interpreting national environmental laws and regulations. As part of the 1998 government reorganization, the agency was upgraded to full ministerial rank. Responsibility for enforcement rests with provincial and local Environmental Protection Bureaus. Responsibility for water management in China is divided among several ministries, including the Ministry of Water Resources and the Ministry of Construction. Water and wastewater utilities are run by municipalities under the direction of provincial and municipal Planning Commissions.

China is implementing a national “one control, two standards” policy, which requires provinces to set limits

61. *Issues Surrounding China’s South-North Water Transfer Project*, U.S. Embassy, Beijing, April 2001.

on the volume of discharges and meet industrial effluent standards.

In general, the responsibility and power of local authorities seems to be increasing. Key cities are required to meet water quality standards. The 1984 Clean Water Law was amended in 1996, requiring all cities with populations over 250,000 to build municipal wastewater treatment plants. The amendments also required industries to pay a "pollution discharge fee" for their effluents.

Although the environmental regulatory framework is comprehensive, enforcement remains a problem because laws established by the central agency are supposed to be enforced by local governments, which are often reluctant, for political, economic, and social reasons, to penalize industries within their jurisdiction. There is evidence, however, that this is changing. For example, late last year in the Huai River area, over 1,000 businesses were forced to close for noncompliance.

In 1997, the State Development and Planning Commission approved policies concerning water conservation. The policies defined the functions of the central and local governments in water resource management. Investment from the central government is earmarked for construction of large-scale, inter-provincial infrastructure projects. Inter-basin and local projects should be financed through local budgets and commercial channels.

One of the largest constraints to the development of the Chinese water and wastewater market is the lack of market pricing for water. High government subsidies for water have meant that water is supplied to consumers at a loss, resulting in a lack of return on investments in water projects for both local and foreign investors. In 1998, China's State Council required a three-year timetable for water price market reform. As a result, the price of water for agricultural use will likely triple in the near future. Urban and industrial users will also face increases. Between 1996 and 1998 alone, the residential water rate in Beijing doubled to 1 RMB per ton. However, it is estimated that the true cost of water is actually 5 RMB per ton.⁶²

The State Development and Planning Commission addressed wastewater treatment pricing in its 1999 *Notice on Increasing Wastewater Fees and Establishing an Urban Wastewater Treatment System*. This rule states that wastewater treatment fees shall be based on operation and maintenance costs of wastewater treatment plants. Urban public utility bureaus will be responsible for collection. Prices have been increased subsequently.⁶³

62. "Beijing Residential Water Rate is 1 RMB per Ton," *Beijing Wambao* (September 10, 1998), 1.

63. *China Environmental Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 2002.

Privatization

Growth rates in different industrial sectors continue to shift the composition of the economy from the public to the private sector. The government has made serious efforts to downsize the large state sector and many state-owned enterprises have been sold or closed. However, the current policy of administrative price controls is at odds with the goal of achieving greater economic efficiency through market-oriented reforms. Recent contracts in water supply indicate that there are opportunities in BOT schemes (see the section on market opportunities). However, foreign exchange guarantees are not readily available and operators often bear all foreign currency risks. The State Development and Planning Commission stipulated that "the government will not provide a direct guarantee for the project return rate. Neither China's state-owned financial nor non-financial institutions are allowed to provide direct guarantee to the project contractor." In 1998, the People's Bank of China further tightened control over the guarantee issue in response to the Asian financial crisis.⁶⁴

The Hong Kong government is looking to privatize water treatment operations over the next five years. A feasibility study is currently underway to assess the different privatization models and evaluate which would be best suited for Hong Kong's market conditions.

Trade and Investment Policy

China is currently negotiating entry into the WTO, which would recognize its role as a major trading nation. Membership would require China to revise and reduce most of its trade barriers. Presently, import tariff rates are divided into two categories: the general tariff and the minimum or Most Favored Nation tariff. Imports from the U.S. are assessed at the minimum tariff rate due to an agreement between the two countries that contains reciprocal preferential tariff clauses. There is a 14 to 30 percent duty on imports of environmental products, with the highest duties imposed on water filtering and purifying machinery.⁶⁵ Five Special Economic Zones (Dalian, Tianjin, Shanghai, Guanzhou, and Hainan), open cities, and foreign trade zones offer preferential duty reduction or exemption.

A common problem faced by many U.S. firms that have entered the Chinese market is the inconsistent ap-

64. "China: Water Treatment and Supply," *International Market Insight*, U.S. and Foreign Commercial Service and U.S. Department of State, 1999.

65. "China: Wastewater Treatment in Guangdong," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

plication of import regulations. In customs procedures, it is not uncommon for the same product to be subject to different levies in different ports, as they each add to the basic import tariff the local jurisdiction's own administrative and miscellaneous fees. This creates uncertainty in the calculation of export costs and impedes the establishment of consistent, long-term commercial ties.

China also administers a complex system of non-tariff trade barriers that include import licensing, quotas, and administration controls such as import registration. The United States is putting considerable pressure on China to reduce tariffs, phase out non-tariff import restrictions, publicize all trade-related regulations, and grant unconditional national treatment to foreign investors as a prerequisite of its accession to the WTO.

China has opened a number of sensitive sectors to investment on an experimental and limited basis and has introduced new incentives for foreign investors designed to modernize Chinese industry. Most of the investment has been in the coastal regions of the five Special Economic Zones and now in the western portions of the country.

The government continues to pursue reforms in foreign exchange controls, taxation, foreign trade, and state enterprise restructuring that affect the foreign investment climate. In 1996, China announced full convertibility of its currency on the current account and instituted new, more liberal regulations allowing both domestic enterprises and those backed by foreign investment to freely convert currencies for current account transactions.

However, China's restrictive foreign trade and investment regulations deny foreign companies national treatment in almost all industry and service sectors. There is also a general lack of transparency and inconsistent enforcement with regard to China's legal and regulatory system, which leads to ambiguities and excessive bureaucratic influence. Although it is at the discretion of procuring government agencies to determine their own suppliers and forms of procurement, a number of project types must first get approval from the central government. These include public construction projects exceeding \$9 million (which would include all water and wastewater infrastructure projects), and foreign enterprises or joint ventures that exceed \$45 million. This approval process may take a long time.

In general, Chinese government procurement is highly centralized and is not known for being transparent. The U.S. State Department has noted that China's procurement practices "have often not been consistent with open and competitive bidding and, for the most part, non-transparent. . . . All information, from solicitation to award,

remains secret and is known only to companies involved or to officials in the planning and industrial ministries."⁶⁶ Tenders for projects funded by international organizations are usually openly announced, whereas most Chinese "government procurement is by invitation only." This scheme is supposed to change under new regulations issued by the Chinese State Development Planning Commission in 1999.

Foreign companies are currently not allowed to engage directly in distributing imported goods in mainland China, although this will change once China joins the WTO. Presently, foreign suppliers must either distribute their products through a Chinese agent, form a joint venture with a Chinese firm, or manufacture the goods locally. Each region has its individual distribution requirements, so hiring multiple agents is essential.

Hong Kong is a free port and does not impose any customs tariff on imports, has no tariff quota or surcharge, and no value-added or general services taxes. Public sector procurement in Hong Kong complies with the WTO's Agreement on Government Procurement.

U.S. Market Share and Competition

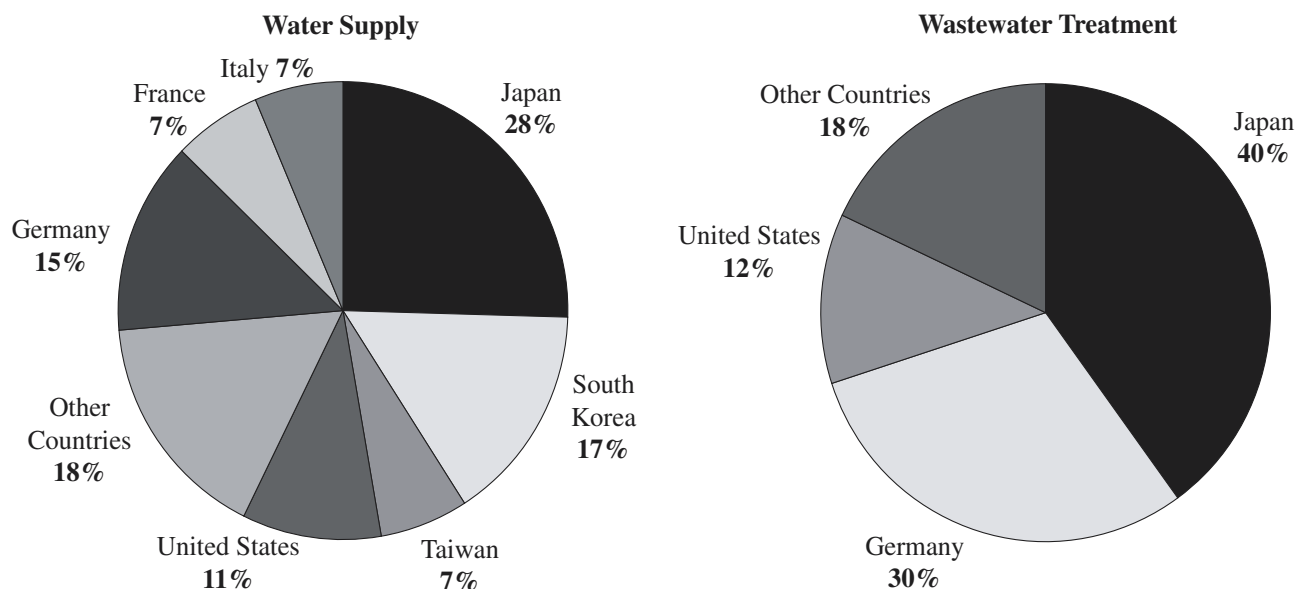
There are currently about 32,000 water equipment manufacturing companies in China and that number is increasing. Although most of these companies produce low-quality, unsophisticated technologies, domestic production should not be underestimated. Domestic suppliers now handle approximately two-thirds of the market. One of the largest environmental firms in Beijing currently supplies 50 percent of the wastewater market in the city, while its branch office in Shenzhen covers 90 percent of the market there.⁶⁷ Domestic production will continue to increase for a number of reasons. One of them is China's desire to become self-sufficient in the area of environmental technologies. Another is that small enterprises are moving into the market because of the opportunities presented by increased government funding.

In 1997, the U.S. had the third-largest import share in both the water supply and wastewater treatment markets (at 11 percent and 12 percent, respectively), after Japan and Germany (see Figure 4.3). The U.S. wastewater technology industry already has a strong presence in the filter technology market, supplying over 60 percent of

66. *FY 2001 Country Commercial Guide: China*, U.S. Department of State and U.S. and Foreign Commercial Service (prepared by the U.S. Embassy, Beijing), July 2000.

67. "China: Wastewater Treatment Technologies," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

Figure 4.3. Import Market Shares for Water and Wastewater Technologies in China



Source: Canada, Department of Foreign Affairs and International Trade, *The Environmental Market in China* (Ottawa, 2001).

wastewater filters in China.⁶⁸ However, it is critical to remember that competition is fierce.

Cost is the primary inhibitor for importing U.S. water and wastewater technology into China. While U.S. technologies are acknowledged to be of superb quality, Chinese buyers are often more concerned with financing and price. Grants from foreign governments strongly affect Chinese end users' purchasing decisions. Japan and many European governments often provide low-interest soft loans with extended repayment terms to help finance their countries' technology exports, giving them a major advantage over U.S. firms.

U.S. competitors are very active in China's emerging BOT market. The 18-year concession in Chengdu (Sichuan Province) was awarded in 1998 to the consortium of Vivendi (France) and Marubeni Company (Japan).⁶⁹ In 1997, ONDEO was awarded a 30-year BOT contract for a 450,000 m³/day drinking water treatment plant in Shenyang, the capital of Liaoning Province. ONDEO also got a similar contract for a 500,000 m³/day drinking water treatment plant in Guangzhou (Guangdong Province), and smaller contracts in Gaozhou (Guangdong Province) and Nachang (Jiangxi Province). Another BOT concession (for 22.5 years) was awarded to a consortium of British companies, Bovis Construc-

tion Group and Thames Water, to build a \$73 million water treatment plant in a district of Shanghai.⁷⁰

The first joint project between a U.S. company and a Chinese partner for the development of a municipal wastewater treatment plant was signed in 1999 between Lemna International and the Guangzhou Tunnel Development Authority. The project is estimated at \$120 million. U.S. firms will supply \$18 million worth of equipment exports and \$2 million worth of environmental services. As the Guangzhou Municipality is looking to undertake 10 similar projects over the next few years, the signing of a U.S. firm for the first project creates a good precedent for other U.S. companies.

The notion of *guanxi* (relationships) is very important to any kind of venture in China. U.S. companies must be willing to develop close relationships with their Chinese partners, as well as local governments. Good personal relationships are often the most critical success factor.

Market Opportunities

Responding to the country's serious water resource problems, the World Bank and the Asian Development Bank have dramatically increased their funding in China on water infrastructure projects, creating significant com-

68. "China: Wastewater Treatment in Guangdong," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

69. Ibid.

70. "Global Environmental Markets 2000." *Environmental Business Journal*, vol. XII, no. 9/10, 2000.

mercial opportunities for U.S. firms.⁷¹ In the past, projects funded by multilateral development banks presented opportunities for foreign companies in Eastern China. As the Chinese government has shifted its focus to promoting development of the western provinces, so have the World Bank and the Asian Development Bank. An estimated \$1.26 billion worth of water supply and wastewater management projects are currently underway or in preparation. (As noted above, large projects funded by international organizations are often more transparent than those funded solely by the Chinese government.)

The following are just some of the water and wastewater projects in China funded through World Bank or Asian Development Bank loans (see Appendix A for more details on these and other ongoing and forthcoming multilateral development bank projects):

- **Beijing Environmental Protection Project** (World Bank). Among the goals of the second phase of this project is to improve the city's sewage collection and treatment system.
- **Shandong Environment Project** (World Bank). The project focuses on wastewater management and efficient use of water resources in the city of Jinan, Shandong province.
- **Hubei Urban Environmental Project** (World Bank). The goal of this \$223 million project is to improve water quality in the urban areas of the mid-Yangtze River basin by constructing intersector sewer systems and wastewater treatment facilities.
- **Chongqing Industrial Reform and Pollution Control Program** (World Bank). This long-term program for water resource management includes construction of wastewater treatment plants as well as upgrading water supply and distribution systems.
- **Liao River Basin Project** (World Bank). The investment component of this river basin pollution cleanup project is expected to include water supply and wastewater management.
- **Huai River Basin Pollution Control Project** (World Bank). The project will help local governments in the Anhui and Shandong provinces develop and finance municipal pollution control investments.
- **Tianjin Wastewater Treatment and Water Resource Protection Project** (Asian Development Bank). The \$300 million project includes the construction of Beicang wastewater treatment facilities

and implementation of a water resource protection scheme for the Luan-Tianjin diversion system.

- **Suzhou Creek Rehabilitation Program** (Asian Development Bank). The \$445 million effort includes improving sewage treatment systems, treating contaminated sediments, and introducing water resource management and quality control methods.
- **Hai and Luan Wastewater Program** (Asian Development Bank). The objective of this \$900 million program is to improve water quality in one of three river basins on the Chinese government's priority list.

Public authorities continue to be the main end-users of water and wastewater technologies and services in China. As domestic Chinese firms are strong in small-scale wastewater treatment technology projects, the best market for U.S. water and wastewater treatment equipment is in large and medium-sized municipal facilities. The greatest demand is for low-cost but highly efficient systems, including aerators, pumps, valves, sludge scrapers and mixers, disinfecting equipment and chemical agent production equipment, water quality monitoring and automatic control systems, dewatering machines, and various kinds of pipes.

In the industrial wastewater treatment market, the best opportunities exist in the pharmaceutical, food processing, fish farming, paper, textile, paint, chemical, and fertilizer industries. These industry sectors are the main targets of the "three lakes, three rivers" government program. There are also opportunities with large multinational companies working in China, many of which are complying with higher, worldwide corporate environmental standards.

In addition, there is an expanding market for smaller water and wastewater facilities in rural areas. For example, Phase II of the Chongqing Urban Environmental Management Project includes an emphasis on provision of infrastructure to rural communities.

Some of the better equipment sales prospects in China are water monitoring instruments, drinking water purification systems, industrial wastewater treatment equipment, and resource recovery technologies.⁷²

The Hong Kong government has designed a Strategic Sewage Disposal Scheme, an ambitious plan to link major urban developments around Victoria Harbor to new sewage treatment facilities. The various options for ultimate disposal of sewage from the metropolitan area are

71. However, loans are capable of supplying a mere 15 percent of the funding requirements, making the lack of hard currency financing an important constraint to accessing China's water and wastewater market.

72. *FY 2001 Country Commercial Guide: China*, U.S. Department of State and U.S. and Foreign Commercial Service (prepared by the U.S. Embassy, Beijing), July 2000.

currently being reviewed. The project's total cost is estimated at \$5.2 billion.⁷³

While Hong Kong by itself represents a strong market for wastewater equipment, it is also a gateway to the enormous mainland China market. Hong Kong remains China's largest port and the entry point for most of China's imports, particularly goods exported by small and medium-sized enterprises.

U.S. water and wastewater equipment and technology are seen as being high quality and cutting edge. However, it is also often more expensive than competitors' equipment and technology. The best sales prospects are in the areas of water monitoring equipment, home water filtration systems, and turnkey solutions to large-scale water treatment problems.

Egypt

Population: 68 million (2000)

Urban population: 45 percent (2000)

GNP per capita: \$1,400 (1999)

GDP average annual growth rate: 4.2 percent (1990-1998)

Water supply coverage (urban/rural): 96 percent/
94 percent (2000)

Sanitation coverage (urban/rural): 98 percent/
91 percent (2000)

Market Overview

The Nile is the source for more than 95 percent of Egypt's water, supplying a large population, a burgeoning industrial base, and over seven million acres of highly productive irrigated lands. The Nile is also the ultimate recipient of Egypt's wastewater. A rapidly expanding population and the disposal of untreated wastes are putting increased demands on the country's water supply.

Only large cities such as Cairo and Alexandria provide treated drinking water to all of their residents. Existing surface water filtration plants use conventional water treatment plant processes consisting of pre-chlorination, aluminum sulfate coagulation/flocculation, sedimentation, rapid sand filtration, and post-chlorination. The municipal water supply is often unreliable, particularly in rural areas. The distribution system cannot satisfy peak demands, and, in some cases, water has to be rationed.

Approximately 40 of 60 Egyptian cities have sewerage systems connected to existing (or under construction)

primary or secondary treatment plants, which provides 70 percent of the urban population with access to some kind of sanitation services. However, 85 percent of the total load of municipal sewage receives little or no treatment. In rural areas, the overwhelming majority of the population does not have access to either sewer systems or treatment facilities. The rural population uses on-site disposal systems—leaching pits, septic tanks adjacent to houses, or direct discharges of raw sewage to drains and canals. The disposal of untreated sewage creates a threat to public health and the environment.

Industrial wastewater discharges are considered one of the major sources of water pollution in Egypt. The major wastewater dischargers in Greater Cairo are metallurgical, sugar, and chemical industries. Large sources of effluents in Alexandria are the pulp and paper, chemical, metallurgical, and textile industries. Industrial wastewater is either discharged directly into the waterways (for example, in the cities of Suez, Port Said, Ismailia) or through municipal systems which discharge into the Nile and its canals. Over 80 percent of industrial discharges do not receive any treatment. Industrial wastewater dumped into public sewers without pretreatment causes damage to sewerage systems through corrosion or by inhibiting biological processes.

In 1998, the total market for water and wastewater technologies in Egypt was \$856 million and growing at an average rate of 10 percent a year. Imports comprised over 90 percent of the market.⁷⁴

Regulatory and Institutional Framework

Wastewater discharges in Egypt are regulated by Law 93 of 1962 (and its Executive Regulations, Decree 649 of 1962) and Law 48 of 1982 (and its Executive Regulations, Decree 8 of 1983). Law 48 prohibits the discharge of untreated wastewater into groundwater and surface waters used as sources of potable water. Discharges of treated wastewater into a waterway require a license from the Ministry of Public Works and Water Resources. Decree 8/1983 contains discharge standards for treated industrial and municipal wastewater to be discharged into potable and non-potable surface waters and groundwater.

Industries in Egypt are required to discharge their wastewater into public sewers, except when they are located outside the coverage area. Decree 649 lists the types of industrial establishments that need licenses to discharge wastewater into public sewers and the standards they must adhere to.

73. *The Environmental Industries Market in Hong Kong*, Canada, Department of Foreign Affairs and International Trade, 2001.

74. Egypt: Water Resources Equipment, *Industry Sector Analysis*, U.S. Foreign and Commercial Service and U.S. Department of State, 1998.

At the national level, Law 4 of 1994 designates the Egyptian Environmental Affairs Agency (EEAA) as the overall national environmental coordination and supervision authority. In addition to the EEAA, many sectoral ministries exercise environmental management responsibilities. The responsibilities of the relevant government agencies in the water sector are summarized below:

- The EEAA coordinates with the appropriate authorities to issue and enforce licenses for projects in the coastal zone.
- The Ministry of Health sets drinking water standards, industrial and municipal discharge standards and monitors the quality of drinking water sources and drinking water quality.
- The Ministry of Housing, Utilities, and New Communities (MHUNC) designs and constructs water supply and treatment systems, sewerage and sewage treatment facilities, issues and enforces licenses for discharges to public sewers, and enforces relevant discharge standards.
- The Ministry of Public Works and Water Resources (MPWWR) issues and enforces licenses for discharges to surface waters and groundwater, enforces relevant discharge standards, and monitors ambient water quality.
- The Ministry of Interior's Water Police Force controls pollution of inland waters and coastal areas.

Enforcement of environmental regulations has been poor and inconsistent. Enforcement responsibilities are generally divided between the EEAA and the sectoral ministries. The level of enforcement depends on the power of responsible authorities and the willingness of officials in the governorates (provinces) and municipal governments to cooperate with these enforcers.

High rates of unemployment make the government a reluctant enforcer where enterprise shut-down is widely, though mistakenly, understood as the only enforcement option available. Furthermore, the fact that the EEAA is not the only enforcement agency complicates enforcement efforts. Since the regulations have been enacted, the Egyptian government realizes that enforcement is costly and technically complex. The government intends, therefore, to focus first on major polluters and assist them in moving toward compliance, while developing a long-term monitoring and enforcement program.

Overall, Egypt's environmental regulatory and institutional framework suffers from:

- the lack of effective operational strategies;
- redundancies and fragmentation of responsibilities between the EEAA, sectoral ministries, governorates, and municipal authorities;

- weak monitoring capacity at the national and local level; and
- limited technical, management, and enforcement capabilities to address the major environmental issues of the country.

Privatization

In the 1990s, the Egyptian government launched a comprehensive Economic Reform and Structural Adjustment Program supported by the International Monetary Fund (IMF), the World Bank, and other international donors. As part of its reform program, the government is focusing on liberalizing its trade regime, encouraging private sector growth, and improving the investment climate.

In 1996, the Egyptian government began to make progress toward selling off state-owned companies. It is considering offering concessions for water and wastewater utilities. For example, as part of its five-year plan (1998–2002), the government is planning to upgrade 150 facilities so that they can be transferred to the private sector, as well as construct 12 new facilities for the new industrial cities through BOT arrangements.

Trade and Investment Policy

One of the key areas of Egypt's economic policy reform has been trade liberalization. In 1995, Egypt joined the WTO. Egypt and the United States agreed in May 1998 to begin talks on a Trade and Investment Framework Agreement (TIFA). The TIFA is expected to be an intermediary step before starting talks on a free trade area agreement at some future date. Egypt has been in negotiations with the European Union on an association agreement under the Mediterranean initiative since 1995. New import and export regulations adopted in January 1998 reduced import duties and eliminated some non-tariff trade barriers. However, Egypt has yet to change many of its protectionist policies.

The 1997 investment law reaffirms basic guarantees for investors and clarifies the framework for investment incentives. In an effort to improve coordination between the central government and the localities on investment issues, Egypt has also established investment offices in the governorates.

However, Egypt has yet to reduce trade barriers and eliminate unnecessary regulations and restrictions on business activities. Law 228/1997 reduces import duties on finished goods that have at least 30 percent local content, from an average of 50 percent to 45 percent. These reductions are part of the IMF-approved economic liberalization program and are meant to encourage invest-

ments in local manufacturing. In addition to the import duty, a sales tax ranging from 5 percent to 25 percent is added to the final customs value of the imported item. The current tariff policies and structures do not give special treatment to environmental equipment.

The domestic industry also remains protected by many non-tariff import barriers, including service fees and the mandatory product inspection list. In addition, administrative procedures regarding customs clearances appear to be causing unnecessary delays to bringing environmental equipment into the country. Egyptian customs authorities do not have to justify their decisions, and there is no formal appeals process. The customs procedures are subjective in determining whether a commodity fits in one tariff category or another, and experience has shown that the same commodity may be classified differently and consequently be subject to different tariff rates under different shipments.

In FY 1999, the U.S. Congress reduced the amount of aid under the Egypt Economic Support Fund, with the objective of moving the U.S.-Egypt partnership from an aid-based relationship to more mature cooperation based on trade. Nonetheless, Egypt remains the world's largest recipient of U.S. foreign assistance, with \$695 million worth of aid expected in FY 2001.

U.S. Market Share and Competition

U.S. companies have a lead in Egypt's water and wastewater sector, mostly due to the large USAID procurements. The U.S. market share was about 35 percent in 1998.⁷⁵ French firms are the main competitors of U.S. suppliers of water supply equipment, while British companies have a high profile in the municipal wastewater treatment market. German and Italian firms are also active in this market.

Market Opportunities

USAID/Egypt operates the largest environmental program of all USAID missions. The United States is also by far the biggest donor for environmental initiatives in Egypt.

Egypt's water and wastewater sector represents enormous opportunities for U.S. equipment suppliers, mostly through direct USAID procurement. USAID's water/wastewater program also supports the commercialization of water and wastewater management through private sector participation, including greater autonomy for utilities in planning, construction, and financial management,

as well as an improved regulatory climate for private investment in the sector.

Over the past 20 years, USAID has invested approximately \$2.6 billion in Egypt's water and wastewater infrastructure.⁷⁶ The following are USAID/Egypt's largest ongoing projects in this sector, all of which involve extensive procurement of U.S. equipment.

Under the Secondary Cities Development project (1994–2002, \$215 million), USAID is expanding water and wastewater infrastructure investments to reach the communities of Mansoura, Nuweiba, Luxor, and the Aswan group of Nasr City, Kom Ombo, and Darawo City. Water and wastewater treatment works include collection/distribution pipeline networks, pumping stations, and storage tanks.

Working with the General Organization for Sanitary Drainage of Alexandria, USAID has invested \$425 million in the design, construction, and start-up of a sewerage system for approximately 75 percent of the city since 1978. The current *Alexandria Wastewater System Expansion II* program (1998–2002, \$90 million) will double the capacity of two treatment plants, upgrade the pumping stations, and improve the sludge disposal systems to accommodate the projected population growth. The *Alexandria Drinking Water* initiative (1998–2002, \$200 million) will assist the Alexandria Water General Authority in implementing its water supply and distribution systems master plan.

The three newly formed Economic General Authorities for Water Supply and Sanitary Drainage in the governorates (provinces) of Fayoum, Beni Suef, and Minya are the partners in the *Egypt Utilities Management* program (1997–2004, \$215 million) to provide water and wastewater services for their residents.

It should be noted that USAID's assistance in Egypt is gradually moving away from infrastructure construction and technology demonstration in the water sector toward greater policy assistance to manage the systems created through past capital investments.

Installation of new sewer and potable water systems, and rehabilitation of old water infrastructure are also major national government priorities in the 1998–2002 five-year plan. The projects tentatively approved by the Egyptian government include:

- Upgrading 1,000 existing compact water treatment units.
- Constructing 500 new units of 2,000–5,000 m³/day capacity.
- Upgrading 26 existing water treatment facilities, including major rehabilitation and repairs.

75. Ibid.

76. *USAID FY 2001 Program Description and Activity Data Sheet*, U.S. Agency for International Development, 2001.

- Installation of 400–600 wastewater treatment units in rural areas (500–2,000 m³/day).

The World Bank has recently launched a Middle East and North Africa Water Partnership program that is designed to energize and harmonize government and donor efforts in the water and wastewater sector. Ultimately, it will increase overall investment in this sector by 200 to 300 percent. The program will facilitate investment from government, donor, and private sector sources for rehabilitation and expansion of water distribution and transfer networks; expansion of wastewater collection and treatment systems; and protection of water quality.

There are opportunities in the municipal wastewater market for foreign companies in environmental engineering and design of new treatment systems, sales of equipment for pump stations and wastewater treatment plants, and, possibly, operation and maintenance contracts for secondary treatment facilities. For joint ventures between foreign and local companies, there are opportunities to construct/expand new sewerage systems, to manufacture and sell components for compact wastewater treatment facilities, and to manufacture and sell PVC pipes and valves. There may also be opportunities for the operation and maintenance of existing water and wastewater facilities.

In the water supply and treatment market segment, attractive business opportunities include sales of compact water treatment units, air blowers, filters, boosters, chemicals, pipes, valves, and turbines. Egypt is also one of the largest water pump markets in the world. Imports of water pumps in Egypt totaled \$100 million in 1999 and the market is expected to grow over the next few years by 15 percent annually.⁷⁷ The public sector's market share of imported water pumps is 70 percent. In the water and wastewater market, the best sales prospects for pumps are for horizontal end-suction water pumps, split case water pumps, and feed water boiler pumps.

Most of the money for imports of U.S.-manufactured industrial wastewater treatment equipment is likely to come from Egyptian private-sector industries, since grants are generally not available in this market segment. The World Bank has established a \$39 million Pollution Abatement Fund under the Egypt Pollution Abatement Project to finance environmental investments through local commercial banks. To qualify, the Egyptian firms must be financially viable existing public and private enterprises. The eligible projects are investments in pollution prevention and effluent pre-treatment.

The biggest opportunities in industrial wastewater treatment will be in food processing (sugar, edible oils, onion dehydration); cement, steel and iron; chemicals and fertilizers; and textiles, especially at factories located along the Nile River.

In the short term, demand will be for unsophisticated technologies that treat the most obvious pollutants and are easily operated and maintained. Process changes, improved housekeeping, and water conservation and reuse will be priorities. In addition, some of the existing systems are not in working condition due to a lack of spare parts and trained operators, which creates a market for spare parts and consulting services.

India

Population: 1.014 billion (2000)

Urban population: 28 percent (2000)

GNP per capita: \$450 (1999)

GDP average annual growth rate: 6.1 percent (1990–1998)

Water supply coverage (urban/rural): 92 percent/
86 percent (2000)

Sanitation coverage (urban/rural): 73 percent/
14 percent (2000)

Market Overview

It is estimated that 70 percent of India's surface water resources are severely polluted. Municipal sources account for about three-fourths of total wastewater generation in volume and almost one-half of the total pollution load in the country. In the industrial sector, although 75 percent of the large and medium-sized enterprises have installed adequate effluent treatment facilities, small-scale industries (particularly in textile, electroplating, and food processing sectors) still lag behind in terms of regulatory compliance.

In India's 23 largest cities (with population of more than 1 million), only 31 percent of wastewater is treated. Three of them have only primary treatment facilities and 13 have both primary and secondary treatment facilities. The biological systems for secondary treatment installed by the municipalities/water supply and sewerage boards of these metro cities include trickling filters, activated sludge with compressed aeration and activated sludge with mechanical aeration, and oxidation ditch technologies.⁷⁸ As a result, the quality of India's water supply is

77. "Egypt: Water Pumps Market," *International Market Insight*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

78. *Business Guide to the Water and Wastewater Treatment Market in India*, Canada, Department of Foreign Affairs and International Trade, 1999.

very poor: only 20 percent of the available drinking water meets health safety standards.

The key factors contributing to the poor operation and maintenance of India's water and wastewater systems are the lack of funding, inadequate data, designs, and survey plans, poor personnel training, and the lack of monitoring. All publicly owned water and wastewater utilities continue to experience economic constraints owing to extremely low user fees for water and wastewater treatment services, limiting their investment potential. Existing water connection charges and user fees are highly subsidized. To meet the funding requirements, a number of utilities/municipalities are trying to raise resources from the municipal debt market.

The 2000 total annual water and wastewater market in India was estimated at almost \$1.2 billion, with the import market size at about 40 percent of this number, or \$472 million. The level of spending in this sector has been increasing at an average rate of 14 to 15 percent over the last four to five years.⁷⁹ The main drivers for this growth are the increased enforcement in the industrial segment and sustained infrastructure funding from multilateral development banks in the municipal segment.

Regulatory and Institutional Framework

India has a comprehensive legal framework for water pollution control. The Central and State Pollution Control Boards implement the Water Act of 1974. The Central Board formulates standards, while the State Boards are in charge of planning and executing environmental programs, including enforcement. Under the 1986 Environmental Protection Act, the Central Board establishes discharge standards on the basis of best available technology, but the State Boards are authorized to apply more stringent standards for a specific category of industries under their jurisdiction, if required. The Water Cess Act of 1977 stipulates the collection of water user fees from certain categories of industries.

There is a clear trend in India's environmental regulations to prescribe more enforceable mass-based loading limits for effluents rather than concentration-based wastewater discharge standards, thereby increasing the demand for effluent treatment technologies. The sharp increases in water user fees and the central government's intent to apply them to all industry sectors rather than only select ones drives Indian industry to identify and exploit opportunities for water conservation. An ongoing policy debate is concerned with the integration of appropriate market-based instruments into the existing command-

Table 4.6. Estimated Size of the Water and Wastewater Technologies Market in India, 2000 (millions of U.S. dollars)

	<i>Local Production</i>	<i>Imports</i>	<i>Total Market Size</i>	<i>Growth Rate, 2000–2001 (percent)</i>
Water Treatment and Supply	593	395	988	13%
Wastewater Treatment	115	77	192	15%
Total	708	472	1,180	

Sources: "India: Water and Wastewater Treatment Market" (2000) and "India: Wastewater Resource Development Equipment" (1999), *Industry Sector Analyses*, U.S. and Foreign Commercial Service and U.S. Department of State.

and-control regulatory regime to provide incentives for cleaner technologies and pollution prevention.

There is also a noticeable trend among leading Indian companies to obtain Environmental Management Systems (ISO 14001) certification for better corporate visibility and global outlook. Over 90 companies in diverse industry sectors have already obtained ISO 14001 certification.⁸⁰ The growing acceptance of ISO 14001 is likely to generate demand in the area of industrial pollution prevention and waste minimization.

Privatization

The government continues to dominate India's infrastructure sectors. Although there is a policy debate on the need to privatize the existing publicly owned water and wastewater treatment works, official policy and guidelines are yet to be framed to give a definite direction to the marketplace.

However, many of India's state and local governments are bringing private sector financing into the development of urban water supply and sewerage systems. Many Indian cities and water boards are entering into service and management contracts to improve the quality of service and reduce costs. These contracts range from labor and service (in almost all Indian cities) to operation and maintenance of water and wastewater treatment plants (for example, in Chennai and Mumbai). BOT and BOO schemes have been implemented in the cities of Tirupur, Pune, Hyderabad, Bangalore, Goa, Kolhapur, Dewas, and Cochin.⁸¹ The following are just three examples of nu-

79. "India: Water and Wastewater Treatment Market," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

80. *Business Guide to the Water and Wastewater Treatment Market in India*, Canada, Department of Foreign Affairs and International Trade, 1999.

81. "India: Water Resource Development Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1999.

merous public-private partnerships in the water and wastewater sector in India:

- The Pune Municipal Corporation has contracted the operation and maintenance of the water supply system to a private company.
- In Chennai, municipal authorities have contracted out the operation and maintenance of 75 pumping stations and are planning to do it for other water supply services.
- A new development program in Tirupur, Corporation Limited, is implementing a \$330 million, 30-year comprehensive BOT scheme for the city's water and sewerage system that would rely for its profitability on the collection of increased water and wastewater fees. The project will supply 185 million liters of drinking water per day and will build a 55 km-long pipeline and about 350 km of water distribution network, drinking water and wastewater treatment plants, pumping stations, and conveyance facilities.

Trade and Investment Policy

India's new Export-Import Policy announced in April 1999 signifies a move in the direction of a more liberal trade regime. India has recently reduced tariffs and removed quantitative restrictions on many items. Import tariff rates have been reduced from a peak rate of 300 percent in 1991 to a ceiling of 30 percent in the 1999/2000 budget. Customs duties for energy-efficient equipment and certain pollution control equipment are lower (5 to 15 percent). India is committed to a phased reduction in duty rates in line with its membership in the WTO.

The new industrial policy introduced in 1991 marked a major shift in India's investment climate, relaxing or eliminating many restrictions on investment and simplifying the investment approval process. The government has expanded the list of industries eligible for automatic approval of foreign investments and also raised the upper level of foreign investments from 51 to 100 percent in 1998. Although the current government led by the Bharatiya Janata Party has taken a more nationalistic stand and advocated a protectionist "swadeshi" (made in India) approach to the economy, it continues to encourage foreign investment in core infrastructure sectors.

As part of its long-time confrontation with Pakistan, India conducted a series of nuclear tests in May 1998 which resulted in the imposition of economic sanctions by many countries, including the United States. Although the Indian government is trying to downplay the negative effect of the sanctions (they do not affect the activities of the U.S. Trade and Development Agency, U.S. Ex-Im Bank, and OPIC in India), they are taking a cer-

tain toll on the country's economy as a whole (due to the reduced foreign assistance) and on the U.S.-India trade and investment climate.

The United States continues to be India's largest trade and investment partner. The potential for expanded trade and investment is enormous but dependent on the future of Indian economic reforms. Under a bilateral trade agreement signed in January 2000, India has agreed to lift more than 1,400 specific trade restrictions for U.S. products by April 2001. However, India is not a member of the Paris Convention on intellectual property protection and does not have a bilateral patent agreement with the United States, which hampers U.S. investment in India.

U.S. Market Share and Competition

More than half of India's market demand for water and wastewater equipment is met by local manufacturers. The current annual turnover of Indian private water and wastewater companies is about \$700 million. Out of this amount, almost 90 percent comes from equipment suppliers and the rest from the consulting business (most equipment manufacturers also offer feasibility assessments and engineering consulting services).⁸² Most Indian water equipment suppliers produce pipes, water pumps, valves, and other relatively unsophisticated equipment. Some of the major Indian companies in this sector are Larsen and Toubro, Subhash Pipes, the GVK Group, Thermax Ltd., Jain Pipes Ltd., and Triveni Engineering & Industries Ltd.

The U.S. Commercial Service estimates the U.S. share of the import market at about 25 percent in 2000, up from 17 percent a year before.⁸³ European firms, especially from France (Vivendi and Degremont), the United Kingdom (Biwater, Bovis Group, Thames Water), and Germany (the Krupp Development Group, Nestler) are very strong competitors. European companies have gained their position because they market aggressively, and their governments extend financial aid to India in connection with water infrastructure development projects. South Korean firms also play a significant role in the Indian water equipment market.

Very often, Western technologies are considered to be expensive in India. To overcome this barrier and remain competitive, it is important to compare both the capital and operating costs of equipment with comparable costs

82. *Business Guide to the Water and Wastewater Treatment Market in India*, Canada, Department of Foreign Affairs and International Trade, 1999.

83. "India: Water and Wastewater Treatment Market," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

of competing equipment. In many cases, a little higher capital investment for equipment would result in lower daily operating costs for the end user. This analysis must be part of marketing strategy since the offered up-front costs of product/services considerably impact the final decision of the end users in India.

Forming a strategic alliance with the right Indian partner is perhaps the most important aspect to getting a niche in the local market. Affiliation with reputable and knowledgeable local partners helps considerably in building relationships directly with end users, adapting to local business cultures, keeping abreast with vital market information and in dealing with local issues. The long-term strategic alliance creates competitive advantage and solid business growth. Therefore, alliances must be forged on a long-term basis. Businesses choosing the local partner should carefully and cautiously consider this fact when considering a local partner.

Indian industry prefers joint ventures or technology licensing agreements where the Indian partner manufactures equipment in India and imports either the design or the core process from abroad. Under such arrangements, Indian companies can manage on-site execution of projects, with the U.S. partner providing the required technological expertise. This approach generates cost savings and competitive advantages for U.S. firms.

Market Opportunities

In the coming years, the level of investment is likely to be higher in India's municipal water and wastewater treatment market segment compared to the industrial one and would be primarily driven by assistance from external donor agencies.

The World Bank and the Asian Development Bank have been the principal sources of external financial assistance. The following are key World Bank and Asian Development Bank projects in water supply and sanitation that are of potential interest to U.S. companies:

- **Third Chennai Water Supply and Environmental Sanitation Project** (World Bank, \$200 million). The project will finance the rehabilitation and expansion of water distribution and sewerage system improvements, including low-cost sanitation.
- **Second Hyderabad Urban Water Supply and Sanitation Project** (World Bank, \$180 million). The project includes the reorganization of the Hyderabad Metropolitan Water Supply and Sewerage Board; reduction of water losses; rehabilitation and expansion of water supply systems; and strengthening and expansion of the sewerage system.

- **Rajasthan Urban Infrastructure Development Project** (Asian Development Bank, \$250 million). This project will finance, among others, a water supply rehabilitation and expansion program and a wastewater management program.
- **Karnataka Urban Development and Coastal Environmental Management Project** (Asian Development Bank, \$175 million). The project will support improvements in water supply and sanitation in the Bangalore sub-region.

Significant market opportunities are also created by the increased public sector funding for water and wastewater infrastructure in India. Under its ninth five-year plan (1998–2002), India's central government will allocate \$300 million for urban and rural water supply projects. The central government-sponsored National River Action Plan is a large source of investments in municipal wastewater treatment. The plan is worth about \$486 million and covers a total of 141 towns in 14 states. In addition, the Indian government has also approved clean-up programs for the Gomti, Yamuna, and Damodar rivers, amounting to \$135 million. These upcoming investments bring good business prospects for U.S. companies for providing wastewater treatment equipment and services.

There is growing policy support in India for common effluent treatment plants for clusters of small-scale industries. In 2000, there were a total of 101 plants around the country. State governments are spending substantial amounts of money for the promotion of these plants. For example, the Delhi government has undertaken an ambitious project to construct 15 plants for 22 industrial estates in the city. Each common effluent treatment plant is expected to cost about \$1.7 million. While 50 percent of this cost will be met by local industries, the Delhi government would provide the remaining 50 percent.⁸⁴

The number of industrial units in common effluent treatment plants could be anywhere between seven and 2,200, but generally varies between 50 and 100. They typically include a screen/grit chamber, equalization tank, flash mixer, clariflocculator, sand filter, aerator, sludge thickener, rotary vacuum filter, and an activated carbon column as part of the treatment chain. These plants represent promising opportunities for U.S. companies producing these technologies.

There are a number of industrial estates that rely on treated wastewater from municipal wastewater treatment plants for their water needs; for example, the Manali in-

84. *Business Guide to the Water and Wastewater Treatment Market in India*, Canada, Department of Foreign Affairs and International Trade, 1999.

Table 4.7. Technology Best Prospects in India's Water and Wastewater Treatment Sector

<i>Subsector</i>	<i>Best Prospects</i>
Water distribution systems	Pumps, valves, motors, compressors, storage tanks, repair equipment for leaking pipes, meters
Municipal water treatment	Ultraviolet disinfection systems, advanced reverse osmosis and membrane filtration systems, aerators, decanters
Municipal wastewater treatment	Advanced oxidation systems, energy efficient aerators, upflow anaerobic sludge blanket systems
Industrial wastewater treatment	Rotary bio-disc systems, sequencing batch reactor systems, automatic chemical dosing systems, oil removal systems, industry-specific pollutant removal/reduction systems
Analytical/monitoring equipment (for all sub-sectors)	Auto-analyzers for phosphorus and nitrogen, thermohydrographs, total organic carbon analyzers, electronic flow meters, continuous pH meters, spectrophotometers, data loggers

Sources: "India: Water and Wastewater Treatment Market" (2000) and "India: Wastewater Resource Development Equipment" (1999), *Industry Sector Analyses*, U.S. and Foreign Commercial Service and U.S. Department of State.

dustrial estate in Chennai. U.S. companies having expertise in water recycling may have a competitive edge in this emerging market niche in India.

The demand for water and wastewater testing and analysis equipment is primarily driven by regulatory enforcement. The growth in this market segment has been relatively low in the last three decades. However, the recent enforcement strengthening trend may create new opportunities. Many state pollution control boards have undertaken major programs to enhance in-house monitoring and analysis capabilities. Moreover, large and medium-sized industrial facilities are also important buyers of state-of-the-art monitoring and analysis equipment and services, since they are now required to regularly monitor their own discharges.

India's private financial institutions are an important source of financial assistance for water and wastewater projects. The most important ones include the Industrial Finance Corporation of India (IFCI), the Industrial Credit and Investment Corporation of India (ICICI), the Industrial Reconstruction Bank of India (IRBI), and the Industrial Development Bank of India (IDBI). IFCI, ICICI, and IDBI provide direct financial assistance (at a 15.5 percent interest rate, for up to 75 percent of the project cost) to large and medium-sized industries to install effluent treatment plants. ICICI also supports technology development ventures, while IRBI provides credit and investment needed for rehabilitation of industrial projects.

Infrastructure Leasing & Financial Services, a private venture capital fund, recently raised \$250 million from debt market for Ahmedabad Municipal Corporation to be used for improving the city's infrastructure and \$425 million for the Tirupur Industrial Area wastewater management project. The Housing Urban Development Corporation has recently created a new urban infrastructure fund that also provides loan assistance to urban water

supply and sewage treatment projects. The total loan assistance approved under the fund in 1997–98 was \$20 million.

U.S. exporters should take advantage of opportunities created by U.S. assistance programs in India. For example, under USAID's Urban and Environmental Credit Program, a loan guarantee of about \$25 million helped launch South Asia's first municipal bond for improvement of water, sewerage, and waste collection systems. This bond, for the city of Ahmedabad, has encouraged 13 other Indian cities to seek credit ratings for future bonds or other debt instruments to finance environmental infrastructure projects. USAID assistance also helped catalyze the Tirupur water supply and sewerage BOT project. The U.S. engineering firm, Bechtel, is part of the consortium that was awarded this project.

In 2000, the U.S. Ex-Im Bank announced a new line of credit of \$500 million (with \$100 million reserved for environmental infrastructure projects) for U.S. firms trying to access the Indian market. US-AEP's technology representatives in New Delhi, Mumbai, Chennai, and Calcutta are working to identify appropriate partners for U.S. firms in the field.

Japan

Population: 127 million (2000)
 Urban population: 79 percent (2000)
 GNP per capita: \$32,230 (1999)
 GDP average annual growth rate: 1.5 percent (1990-1998)
 Water supply coverage (total): 96 percent (1990-1996)⁸⁵
 Sanitation coverage (total): 100 percent (1990-1996)⁸⁶

85. *World Development Indicators*, World Bank, 2000.

86. Ibid.

Market Overview

Almost 30 percent of rivers and about 60 percent of lakes and reservoirs in Japan exceed national water quality standards,⁸⁷ primarily because the country has been slow to develop municipal wastewater treatment systems and has not sufficiently enforced industrial effluent standards. In addition, the rapid growth of metal plating, precision machinery, and electronics industries has led to increased discharges of organic chlorine solvents.

The market for wastewater treatment equipment in Japan was estimated at \$6 billion in 1996. The market is growing at a rate of 5 to 8 percent a year and is expected to exceed \$10 billion in 2010.⁸⁸ The Ministry of Construction's eighth sewerage development plan envisioned spending over \$217 billion on municipal wastewater treatment between 1996 and 2002.⁸⁹

Regulatory and Institutional Framework

Japan's Water Pollution Control Law, which was amended in 1996, establishes two categories of national effluent standards, one for public health and one for environmental protection, that are implemented by the national environmental agency. Prefectural and municipal governments can promulgate more stringent standards if warranted by local environmental conditions.

Prefectures and municipalities are responsible for water supply and sewerage within their jurisdictions. Japan's municipal water supply and sewerage infrastructure is publicly owned and operated.⁹⁰ The Ministry of Construction is in charge of implementing water and wastewater infrastructure development projects.

Trade and Investment Policy

The Japanese government has removed or liberalized most legal restrictions on foreign investment. However, direct foreign investment levels have remained small relative to the size of the economy, reflecting a range of long-standing structural impediments, including:

- a high overall cost structure that makes market entry and expansion expensive;
- corporate practices and market rules that inhibit foreign acquisition of Japanese firms; and
- exclusive buyer-supplier networks and alliances, still maintained by some Japanese companies belonging to the same business grouping (or *keiretsu*), which limit competition from foreign firms.

There are no regulations restricting the access of foreign manufacturers to the Japanese market. The Japanese government subsidizes purchasers of environmental equipment, both domestically produced and imported, by granting special tax deductions or low-interest loans.

Japan has instituted a number of programs to support imports that are administered through the Japan External Trade Organization (JETRO). JETRO's activities are designed to support industrial cooperation, promote two-way direct investment, and disseminate market information. JETRO's Technology Tie-up Promotion Program links foreign companies with their high-tech Japanese counterparts for various types of strategic alliances, including joint ventures, joint research and development projects, and technology imports.

U.S. Market Share and Competition

The market is highly competitive with a large number of Japanese suppliers. There are about 120 water and wastewater equipment manufacturers in Japan, nearly half of them large companies. The main players are the Ebara Corporation, Kubota Corporation, Kurita Water Industries, and Mitsubishi Heavy Industries, which have a combined 27 percent share of Japan's water and wastewater equipment market.⁹¹ Ebara manufactures a great variety of water supply and treatment equipment (filters, water conditioning equipment, membranes, pumps, valves, etc.), as well as wastewater treatment equipment (effluent recycling systems, physical and biological treatment systems, chemicals, sludge handling equipment, etc.). It also provides plant design and construction, process engineering, and consulting services. Mitsubishi offers a similarly wide array of equipment and services in this market. Kurita specializes in membrane technologies, wastewater treatment chemicals, and sludge reduction systems. Kubota is a major pipe manufacturer. Japanese companies have managed to satisfy most of the market need by adapting relevant technologies that already exist in the country.

The Japanese government also sponsors the development of new water and wastewater technologies by do-

87. "Japan: Wastewater Treatment Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

88. "Environmental Market in Japan," *International Market Insight*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

89. "Japan: Wastewater Treatment Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

90. There was not enough information to have a separate privatization section in the Japan profile.

91. Ibid.

mestic suppliers. For example, the ACT-21 technology development project (to be completed in 2001) targets the design of new drinking water treatment and treated wastewater recycling technologies.

There is no publicly available information on Japan's imports of water and wastewater equipment, since Japan has no customs classification on environmental products. However, indirect evidence shows that these imports are insignificant. In cases where foreign equipment is used, it is usually produced locally under licensing arrangements rather than imported.⁹² Foreign companies find it difficult to compete in the Japanese market due to the considerable time and costs required to modify equipment to meet regulatory standards and various local user specifications. The top two exporters of wastewater equipment to Japan are the United States and Germany.⁹³

U.S. water and wastewater equipment suppliers have been successful in the Japanese market in a few technology areas, including reverse osmosis and nanofiltration technologies, as well as water quality analysis instrumentation. The successful U.S. companies (Dow Chemical, Pall Corporation, Perkin-Elmer, Millipore, and several others) have established themselves in Japan for the long term and maintain local wholly owned subsidiaries. U.S. firms have to compete against local suppliers not only in price and technology, but also in maintenance costs, energy, and space efficiency, which is so important in Japan. The long-term competitiveness of U.S. companies doing business in Japan also depends on their ability to be very customer-oriented and meet the extremely high Japanese standards for quality, product durability, and after-sale service.

Market Opportunities

The activated sludge process has been used in Japan extensively for decades for both municipal and industrial wastewater treatment. However, in recent years, the anaerobic digestion process has become increasingly popular because of its smaller required installation space, lower operating costs and sludge volume generated. This trend creates opportunities for U.S. exporters of this technology. Other best sales prospects include high-performance filters, industrial wastewater recycling systems, sludge dehydration equipment, as well as sampling, analytical, and monitoring instrumentation.

92. "Japan: Wastewater Treatment Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

93. *The Environmental Market in Japan*, Canada, Department of Foreign Affairs and International Trade, 1999.

Machinery manufacturing, food processing, steel, and chemical industries present the greatest opportunities for suppliers of industrial effluent treatment equipment.

Mexico

Population: 99 million (2000)

Urban population: 74 percent (2000)

GNP per capita: \$4,420 (1999)

GDP average annual growth rate: 3.1 percent (1990–2000)

Water supply coverage (urban/rural): 94 percent/
63 percent (2000)

Sanitation coverage (urban/rural): 85 percent/
32 percent (2000)

Market Overview

Mexico's water market is the single most important market for U.S. exports of environmental equipment and services because of the need for infrastructure investments, the country's proximity to the United States, and the strong trade relationship between the United States and Mexico.

Currently, more than 13 million urban residents in Mexico do not have access to potable water due to the lack of infrastructure. The number is much higher in rural areas. The mismanagement of water supplies is also a big problem—an estimated 40 percent of potable water is lost through leakage.⁹⁴ There has been some improvement over the last few years. For example, the percentage of residents having access to potable water has increased to 87.4 percent.⁹⁵

Wastewater treatment, both industrial and municipal, is inadequate. Only 17 percent of wastewater is treated at all, and only 12 percent to regulatory standards.⁹⁶ Sixty percent of industrial wastewater is discharged directly into open waters.⁹⁷ It is estimated that Mexico will have to invest approximately \$7.2 billion and spend about \$1 billion annually to meet wastewater treatment standards.⁹⁸

94. *The Environmental Market in Mexico*, Canada, Department of Foreign Affairs and International Trade, 2000.

95. *Mexico Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, Office of Environmental Technologies Industries, 2001.

96. Ibid.

97. The largest generator of industrial effluents is the sugarcane industry (40 percent), followed by the chemical industry (18 percent), the rest coming from the pulp and paper, petroleum, beverage, textile, iron and steel, electronics, and food processing industries.

98. National Ecology Institute, quoted in the *Mexico Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 2001.

According to the country's National Water Commission (CNA), only about 8 percent of industrial wastewater and 15 percent of municipal sewage is treated.⁹⁹ Nearly one-quarter (200) of the existing municipal wastewater treatment plants are out of operation. While the largest corporations have made real improvements in treating their wastewater, the same cannot be said for smaller companies.

Two areas of Mexico are facing particular problems with respect to water and wastewater. The first is Mexico City, home to 20 million people. Mexico City must supplement its meager local water resource at great cost by pumping water from 127 kilometers away. In addition, overexploitation of aquifers for drinking water has resulted in rapid land subsidence (at the rate of 50 centimeters annually) and damage to the infrastructure. In addition, the capital city alone accounts for 50 percent of the sewage collection in the country, and the sewage treatment is inadequate. In fact, Mexico City's sewage flows into a river used for irrigation purposes, creating a substantial human health hazard.

Another area with acute water-related problems is the U.S.-Mexico border, which stretches 2,000 miles. The operation of some 2,000 maquiladoras (in-bond plants that operate under special Mexican customs treatment and preferential foreign investment regulations) has produced an enormous population shift to the border region, where there was little infrastructure to support the booming development. The lack of adequate drinking water supply infrastructure and disposal of untreated industrial and municipal effluents (sometimes directly into the sources of drinking water) have resulted in severe health risks to the border communities.

The Mexican government recognizes water and wastewater management as one of the top priorities of its market-oriented program. Water prices have risen dramatically in recent years as the government has removed subsidies and begun to implement cost-recovery pricing. The other major direction of the government program was to involve the private sector (mostly through 10 to 15 year concessions) in the improvement and management of Mexico's water and wastewater infrastructure. With the exception of rural areas, the government expects much of the funding for new and rehabilitated wastewater treatment plants to come from the private sector. The United States has been very active in this region, investing approximately \$2.5 billion dollars to address environmental infrastructure needs of border communities.¹⁰⁰

These programs, together with a huge need for investment, have created a large water and wastewater market in Mexico. Its size was expected to reach \$2.39 billion in 2000, with annual growth of about 10 percent.¹⁰¹ The water supply market segment alone was estimated at \$1.9 billion in 1999, with a 5 to 7 percent growth rate per year.¹⁰² The industrial wastewater treatment market is much smaller, just \$94 million in 1998, but is growing at a much faster rate of 16 to 18 percent annually. The share of imports in the overall market is about 80 percent.¹⁰³

Regulatory and Institutional Framework

The system of effluent permits is a key element of Mexico's water and wastewater management program. The previous system of industry-specific effluent limits was replaced in 1997 with a simpler system based on specific pollutants and the type of receiving waters (for direct discharges). Although the standards are tougher in heavily contaminated areas, they are, overall, less stringent than under the previous regulation and allow municipalities to limit themselves, in most cases, to primary wastewater treatment.

Compliance deadlines for municipalities vary depending on their population: the year 2000 for cities and towns with over 50,000 residents, and 2005 and beyond for smaller communities. Industry compliance deadlines are based on daily BOD discharge volumes and are, similarly, the year 2000 for facilities discharging more than 3 tons/day, and 2005 and beyond for those that discharge less.

At the federal level, the CNA has ultimate responsibility for water resources and is responsible for enforcing effluent standards for direct discharges.

Each of the states has its own water law, which determines how water services are provided and the way in which water tariffs are set. These laws also specify how much private participation is allowed in the provision of services and development of infrastructure.

Mexican municipalities are responsible for providing water and wastewater treatment within their jurisdictions. New regulations covering discharges into sewerage systems were promulgated in 1998. Since the municipality is responsible for the quality of the wastewater it discharges to open waters, it has an incentive to ensure that industries pretreat their effluents and comply with stan-

101. *FY 2001 Country Commercial Guide: Mexico*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

102. "Potable Water Resource Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1998.

103. "Industrial Wastewater Treatment and Recycling Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1997.

99. *The Environmental Market in Mexico*, Canada, Department of Foreign Affairs and International Trade, 2000.

100. *Mexico Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 2001.

dards for indirect discharges. Otherwise, the municipality must pay related effluent charges.

One important characteristic of the regulatory climate is the tension between federal and local governments regarding large municipal water and wastewater projects. Priority municipal wastewater projects in Mexico City and Guadalajara have been stalled due to political disputes between the federal and local governments.¹⁰⁴

CNA's staff shortages and the limited availability of monitoring equipment have impeded enforcement of water laws in Mexico. Enforcement efforts were reduced in the wake of the 1995 economic crisis (in order to avoid even higher unemployment) but are picking up again. Under a recent regulation, state and municipal authorities are now responsible for enforcing the standards for small and medium-sized enterprises. At the same time, there are discussions about integrating CNA's enforcement activities with those of the Office of the Attorney General for Environmental Protection, which prosecutes environmental violations not related to water.

Rapidly rising water prices are encouraging voluntary compliance by industry, since companies are allowed to draw free water to match discharges that meet new standards. Federal tax incentives, including immediate depreciation of environmental investments, also stimulate voluntary compliance efforts.

Privatization

In 1996, there were 360 municipal water utilities in Mexico, 207 of them financially autonomous, and the rest receiving government support.¹⁰⁵ Many municipalities have been having difficulty managing their responsibilities to provide water supply and sewerage services to the population. The infrastructure was usually built by the federal government, and local councils have little experience with the technical and financial issues involved.

The Mexican government has chosen to pursue a number of strategies to involve the private sector in the water and wastewater infrastructure markets. These strategies include integrated concessions, management contracts, partial concessions, and BOT arrangements.

In the concession schemes, the local government provides a contract to a private operator for the operation of their entire water system (an integrated concession) or a portion of the water system (a partial concession). Two cities—Aguascalientes and Cancún—have adopted integrated concessions. Although there have been a number of problems, the arrangements in these two cities are seen

as successful. The replicability of these schemes is limited, however, by the uniquely affluent nature of these two cities.

Under a management contract arrangement, a private company is paid a fee for meeting improvement or performance benchmarks. This arrangement has proved successful in a number of cities including Mexico City and Puebla. Management contract schemes are likely to be implemented in other large cities and constitute an opportunity for U.S. firms with experience in water system management or that sell efficiency-enhancing equipment, services, or software.

The government has opted to involve the private sector through BOT projects in a number of areas. The Water Law of 1992 sets out guidelines for private sector participation in water supply projects in Mexico. However, the high capital costs and the risks of collecting water and wastewater fees from financially troubled municipalities have made the envisioned wide-scale implementation of the BOT program difficult. Out of 40 BOT projects planned in 1993, only eight were operational in 1998.¹⁰⁶

The federal government in most cases cannot step in to help assure private investor repayment. Water utilities that can show a strong balance sheet (only an estimated 10 percent of them can), or projects which by themselves can demonstrate a low level of commercial risk, are eligible to benefit from the Public Works and Services Bank revolving contingency fund. This fund has been used to absorb some of the commercial risk associated with short-term municipal failure-to-pay. The mechanism, though limited, has been indispensable in closing financing for most municipal BOT wastewater projects. Projects with access to international funding are clearly the most attractive to investors and equipment suppliers.

The shortage of funds is causing a trend toward regional projects that would cover the needs of more than one municipality. The state governments are also encouraging the integration of water supply and wastewater treatment projects under one BOT scheme.

Trade and Investment Policy

Mexico's trade policy toward the U.S. has been influenced by the requirements of NAFTA, which was enacted in 1994. NAFTA continues to be a key factor in boosting Mexico's imports and raising its overall level of economic activity, as well as spurring competitiveness and institutional reform. To comply with NAFTA requirements, Mexico has further lowered its tariffs on goods originating in the United States and Canada. Mexican

104. *Mexico Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 2001.

105. *The Environmental Market in Mexico*, Canada, Department of Foreign Affairs and International Trade, 2000.

106. Ibid.

tariffs on U.S. goods are now between 0 and 10 percent of value. Eighty-five percent of U.S. goods now enter Mexico duty-free. Additionally, Mexico has abolished its import licensing requirements for most goods that originate in the United States.

The 1993 foreign investment law has opened more areas of the economy to foreign ownership. It has also provided national treatment for most foreign investment, eliminated all performance requirements for foreign investment projects, and liberalized criteria for automatic approval of foreign investment proposals.

Since Mexico is a neighboring country, it is a natural market for U.S. companies. U.S. exporters have a great competitive advantage in Mexico due to the political, economic, and cultural ties between the two countries. Underlying the strong U.S. position is also a genuine respect for and interest in U.S. products and companies. Mexico largely embraces U.S. standards, business practices, and consumer styles. In 1997, Mexico overtook Japan as the second-largest importer of U.S. goods, second only to Canada. In 1999, the United States accounted for 74 percent of Mexico's imports.¹⁰⁷

U.S. Market Share and Competition

The demand for water and wastewater equipment and services from U.S. firms is expected to grow at an an-

nual rate of about 14 percent in the short term. U.S. imports in this market equaled \$1.4 billion in 2000,¹⁰⁸ with an import market share of up to 70 percent, depending on the market segment (see Figure 4.4). U.S. firms have a natural competitive advantage in the Mexican market due to geographic proximity, U.S. bilateral aid, the free trade regime under NAFTA, and the established reputation of U.S. products. Other imports come mainly from Japan (which has recently been increasing its market share), Germany, France, and the United Kingdom.

Local production accounts for about 20 percent of the total market. Mexico has over 350 local manufacturers of water and wastewater equipment, 95 percent of which are small and medium-sized companies. However, Mexican companies produce only basic water equipment. The most common problems faced by domestic manufacturers are low-scale production, high costs, and obsolete technology.

Market Opportunities

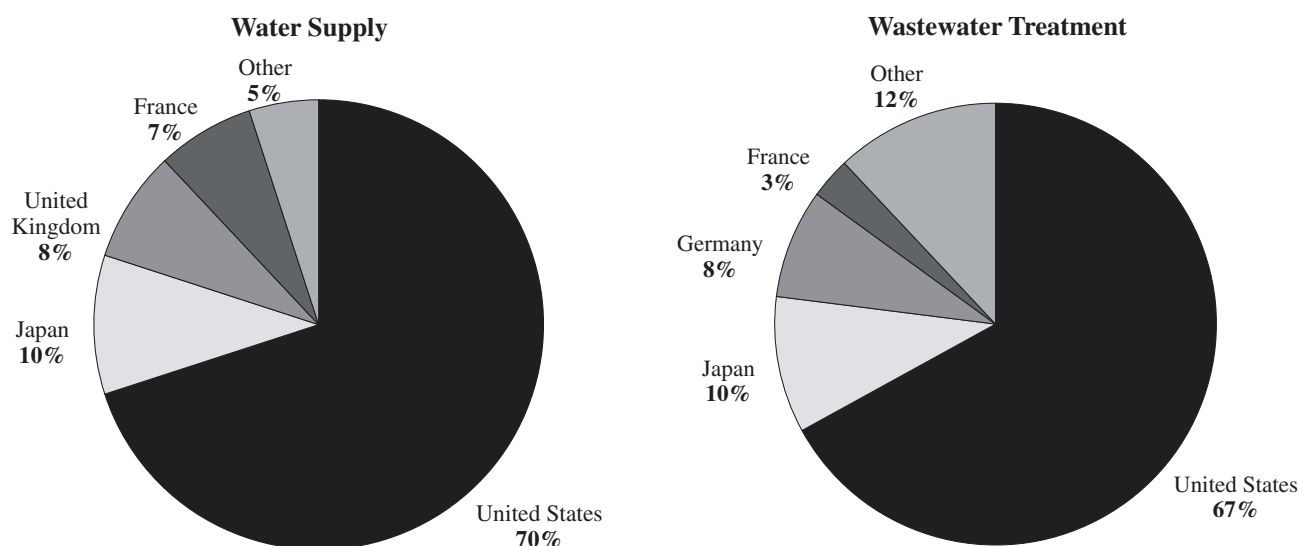
Opportunities exist at all levels for U.S. companies in the Mexican water and wastewater market. Table 4.8 identifies some of the market opportunities in Mexico.

The Mexican government actively supports water and wastewater projects. The federal government designed the National Program for Potable Water and Sewerage

107. *FY 2001 Country Commercial Guide: Mexico*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

108. *Ibid.*

Figure 4.4. Import Market Shares for Water and Wastewater Technologies in Mexico



Sources: U.S. and Foreign Commercial Service and U.S. Department of State, *Potable Water Resource Equipment* (Washington, D.C., 1998); and *ibid.*, *Industrial Wastewater Treatment and Recycling Equipment* (Washington, D.C., 1997).

Table 4.8. Market Opportunities for U.S. Companies in Mexico

<i>Level of Government</i>	<i>Type of Market Opportunities</i>
Federal–National Water Commission (CNA)	Technology for water well drilling, water reinjection systems, emergency response, and water monitoring services
Municipal and State Level	Pumping stations, water networks, water metering, billing and collection systems, wastewater treatment, equipment maintenance, and potabilization plants.

Source: *Mexico Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 2001.

in Urban Zones (APAZU) to support local water utilities in improving their services. The program provides matching funds to improve administrative, financial, and operational efficiency, and to upgrade infrastructure. CNA has plans to invite private companies to build and/or modernize municipal wastewater treatment plants under the BOT scheme in the states of Guerrero, Veracruz, San Luis Potosí, Puebla, Tlaxcala, Hidalgo, and Michoacán. CNA also has projects to modernize the potable water distribution and sewage systems in the cities of Pachuca, San Luis Potosí, Huatulco, Acapulco, Cancún, Tabasco, and Hermosillo, among others.

Companies specializing in water utility operations may have opportunities through APAZU and other funding programs to help Mexican water utilities improve their efficiency, a top federal priority. Some of the principal competition here will come from low-cost, sole proprietors that operate in the Mexican water utility market. BOT projects are also a good market for U.S. engineering firms.

The municipal water supply and wastewater treatment market presents the biggest export opportunities for U.S. firms in Mexico. Private participation in the provision of potable water and sewerage is expected to grow as states and municipalities seek efficiency gains and to attract private capital.

At least 100 tenders are planned for the next five to 10 years to renovate and repair the existing drinking water distribution infrastructure in major cities, as well as to build or upgrade over 50 water or wastewater treatment plants.¹⁰⁹ It is important to note, however, that the planned construction of wastewater treatment facilities under BOT arrangements has been slow as the cost of this infrastructure exceeds many local communities' capacity to pay.

Under the present regulatory regime, most new municipal wastewater plants will now emphasize primary treatment with some exceptions, such as plants discharging into international waters on the border with the United States. Because primary treatment generally requires

fewer imported components and expertise, most U.S. project developers and equipment suppliers should develop new strategies to add value in the wastewater treatment market. One such strategy includes targeting for treatment the substantial volumes of sludge that these treatment plants are likely to generate.

The best prospects for municipal water and wastewater treatment equipment include chlorinators, chlorine diffusers, chlorine contact chambers, mixed sludge pumps, primary clarifiers, PVC pipes, water meters, water filtration equipment, water pumps, valves, and water leak detectors.

A number of U.S. and international agencies have sponsored water and wastewater projects in Mexico. These include the U.S. Environmental Protection Agency (EPA), the U.S. Geological Service, the World Bank, NADBank, and the Border Environment Cooperation Commission (BECC).¹¹⁰ The U.S. EPA, NADBank, and BECC are making substantial investments in water supply and wastewater treatment infrastructure projects along the U.S.-Mexico border. These projects, and others along the border, are good possibilities for U.S. companies.

EPA is represented on both the NADBank and the BECC's board of directors and is the primary source of construction grants for the projects. EPA grants are used to supplement funding for projects which cannot be completely financed by NADBank, state or local governments, or the private sector. The United States expects to provide \$700 million in federal grants for water and wastewater infrastructure construction between 1995 and 2005; Mexico also provides significant grants. There are currently over a dozen NADBank water/wastewater projects in the U.S.-Mexico border area, with a total value of \$400 million.

The industrial sector offers extremely good market opportunities for U.S. technology and services companies, particularly in wastewater treatment. This market is driven in large part by the need to comply with the

109. *Environmental Market in Mexico*, Canada, Department of Foreign Affairs and International Trade, 2000.

110. BECC funds feasibility studies, assists in infrastructure design, and consults on the planning process. To secure BECC certification, a project must fulfill financial, political, sustainability, and technical criteria. NADBank works with a variety of project funding sources to assemble a finance package for each project certified by the BECC.

new effluent standards. At the outset, the new standards will apply only to larger firms, but voluntary compliance is beginning to drive the demand from smaller scale operations. Many industrial parks or groups of smaller companies seek to install common treatment facilities to share design, construction, and maintenance costs. The largest demand exists in the sugar, beverage, petroleum, petrochemical, chemical, iron and steel, food processing, pulp and paper, and textile industries.

A number of constraints affect U.S. participation in the market for industrial wastewater treatment. The cost of capital remains high in Mexico, and many industrial customers are looking for relatively inexpensive short-term solutions. Equipment that can be retrofitted to existing production systems is generally preferable to equipment that requires re-engineered technological processes. The best opportunities in industrial wastewater treatment are for ion exchangers, reverse osmosis modules, analyzers, chemical purifiers, automatic control instrumentation, etc.

In addition, systems designed for use in the United States tend to be engineered to minimize the number of required operators or technicians. This important selling point in the United States may hinder sales in Mexico. For one, many water utilities and industrial facilities in Mexico are more comfortable operating treatment plants manually instead of using sophisticated, automated systems, and believe that manual operation is a less expensive approach given Mexico's low labor costs. U.S. firms must assess the degree to which their systems can be adapted to substitute labor for capital intensity, as well as educate their Mexican clients on the benefits of applying advanced, labor-reducing technologies.

Many companies also seek firms that can demonstrate technology performance under Mexican conditions. This is the result of Mexican clients' unwillingness to accept perceived technology risk. Some foreign firms address this issue by initially accepting low profit margins in order to establish a track record in Mexico.

Finally, finding industrial wastewater treatment projects can be difficult. One strategy to circumvent this problem is to be in constant communication with chambers of commerce, associations, and industrial groups in Mexico.

Republic of Korea (South Korea)

Population: 47 million (2000)

Urban population: 82 percent (2000)

GNP per capita: \$8,490 (1999)

GDP average annual growth rate: 6.1 percent (1990–1998)

Water supply coverage (urban/rural): 97 percent/
71 percent (2000)

Sanitation coverage (urban/rural): 76 percent/
4 percent (2000)

Market Overview

South Korea has made a substantial effort to provide adequate, clean water for its population. However, water resources remain at risk in terms of quantity and quality. With further urbanization and industrialization, the demand for water is on the rise. Many conventional water sources have already been tapped and the main water sources are becoming increasingly contaminated. The growing disparity between water supply and demand is likely to lead to more frequent, more prolonged, and more severe water shortages. South Korea's anticipated water deficit will grow substantially over the next 10 years from 702 to 2,011 million m³ per year. On average, 28 percent of South Korea's water is unaccounted for, due to unauthorized use and distribution system losses.¹¹¹

Only 68 percent of municipal sewage is treated. To bring this rate up to 80 percent in 2005, the South Korean government has committed to expanding basic water treatment facilities and enhancing the management methods. In 2001 alone, the government will construct 30 wastewater treatment facilities and 4,000 km of new pipeline at a value of \$2.1 billion.¹¹²

The South Korean government is currently implementing a plan to clean up the four major river basins in Korea: the Han River, the Keum River, the Youngsan River, and the Nakdong River. The Four River Basin Project's objective is to improve ambient water quality to make the rivers suitable to serve as drinking water sources. The project includes the construction of 199 new wastewater treatment plants worth a total of \$8.8 billion in investments by 2005.¹¹³

The demand for water and wastewater technologies in South Korea went down briefly as a result of the 1997–1998 economic crisis but recovered quickly due to the successful large-scale corporate restructuring and the introduction of government incentives for foreign investment in South Korea.

The U.S. State Department estimates that the market size of South Korea's water pollution control sector in

111. Lee Boug Young, *Water Korea* (on the Internet at <http://my.netian.com/~watopia/index.html>).

112. *Projects in 2001*, Ministry of Environment, Republic of Korea, 2001 (www.me.go.kr/english/newindex.html).

113. *Rivers and Reservoirs Clean-Up Project in Korea*, U.S. Department of Commerce, International Trade Administration, 1999.

2000 was \$3.4 billion.¹¹⁴ Government spending on water and wastewater is another indicator of market size. In 1999, for example, the South Korean government budgeted approximately \$500 million for water and wastewater infrastructure improvements, including \$200 million for water treatment and \$300 million for wastewater treatment.¹¹⁵

Regulatory and Institutional Framework

Several ministries and agencies in South Korea are involved in water and wastewater issues. The Ministry of Environment administers the Water Supply Act, the Sewerage Act, the Water Quality Preservation Act (which regulates industrial effluents), and the Environmental Policy Act, and is responsible for regulating, monitoring, and enforcing water quality control. The Ministry of Construction and Transportation and the state-owned Korea Water Resources Corporation (KOWACO) play the lead roles in water resources development and management, and infrastructure project implementation. Local governments have the responsibility to provide water and wastewater services to the population. At the same time, many other Korean agencies have overlapping water pollution control responsibilities, resulting in significant management inefficiencies.

Among the Ministry of the Environment's major objectives for 2001 are the establishment of a drinking water demand management system and comprehensive water pollution control programs. The Ministry's activities will include:

- The establishment of mandatory water demand management practices for water suppliers (for local governments and KOWACO) and every public institution;
- The introduction of water-saving companies to promote the use of water conservation and water recycling equipment;
- The promulgation of more stringent water quality standards; and
- The enactment and implementation of special management laws for each of the four main river basins, including more stringent effluent regulations and rigorous water monitoring systems.¹¹⁶

114. *FY 2001 Country Commercial Guide: Korea*, U.S. Foreign and Commercial Service and U.S. Department of State, 2000.

115. *Environmental Market Outlook for Korea*, U.S. Department of Commerce, International Trade Administration, 2000.

116. *Projects in 2001*, Ministry of Environment, Republic of Korea, 2001 (www.me.go.kr/english/newindex.html).

Privatization

South Korea is beginning to undertake privatization of the water industry. South Korea's privatization plans were first formulated in 1995. The government hopes that privatization will reduce the financial burden on central and local governments, accelerate the completion of water and wastewater infrastructure projects, promote the reform of local governments' ineffective management systems, trim payrolls, and introduce the latest environmental technologies and services to South Korea.

Municipal water and wastewater utilities will mostly be privatized under a BOT system and will be eventually returned to the South Korean government. Presently, a portion of the water systems controlled by KOWACO are managed by private operators under franchise agreements.¹¹⁷

Trade and Investment Policy

In line with its multilateral trade and other commitments, including those with international financial institutions, South Korea has undertaken changes in its trade policy framework. Import tariff rates have been adjusted in accordance with South Korea's binding WTO commitments. Presently, import duties for pollution control equipment are at about 6 percent. Efforts have also been made to streamline customs clearance procedures by, among others, introducing an immediate release system and the progressive introduction of an electronic clearance system.

In addition to advance implementation of the WTO agreement on trade-related aspects of intellectual property rights, protection of such rights has been strengthened by new treaties, increased international cooperation, and stricter enforcement. The 1998 Foreign Investment Promotion Act has opened 99 percent of industrial sectors to foreign investment, simplified administrative procedures, and expanded tax incentives for high-technology investments. Trade and foreign investment liberalization has also contributed to intensified competition in the domestic market.

The United States is one of South Korea's main trading partners (in addition to the European Union and Japan). In fact, South Korea is the United States' sixth-largest export market, bigger than those of Australia, Brazil, China, France, or Italy. U.S. exports to South Korea are increasing and are expected to continue to show double-digit growth. The European Union is the main competitor in this market and has overtaken the United

117. *Rivers and Reservoirs Clean-Up Project in Korea*, U.S. Department of Commerce, International Trade Administration, 1999.

States as South Korea's largest investor.¹¹⁸ Although there is no bilateral trade agreement between the United States and South Korea presently, both parties have been working toward crafting one.

U.S. Market Share and Competition

Local manufacturing accounts for 60 percent of South Korea's water and wastewater market. Almost all municipal water and wastewater treatment projects in South Korea have been awarded to large local environmental engineering and construction companies, many of which are affiliated with such large industrial conglomerates as Hyundai, Samsung, Sunkyong, Ssangyong, Halla, and Lotte. However, in order to be competitive, South Korean companies need state-of-the-art technology, much of which is offered by U.S. suppliers.

Some South Korean companies invest in the development of cutting-edge technologies (for example, Keumho Construction has invested \$2 million to design a high-efficiency wastewater treatment process) and often look for joint venture partners to leverage their capacity. These joint ventures offer excellent opportunities for U.S. companies and provide a source of superior technology for South Korean projects. It is important to note, however, that the South Korean government is investing heavily in the growth of its own environmental technology industry. Eventually, even a larger share of market demand will be met domestically. For now, however, U.S. companies can still play a large role in the South Korean water and wastewater market.

Currently, the U.S. share of the South Korean environmental market is 20 percent.¹¹⁹ The information on the U.S. share of the water and wastewater market was unavailable at the time of this writing.

International reputation, reliability, and price are the most important factors in government procurement decisions for municipal projects in South Korea. Product specifications are determined by the state-run Environmental Management Corporation, and the equipment is purchased through the Supply Administration of the Republic of South Korea.

Market Opportunities

In 1996, the South Korean government established comprehensive measures for water quality management. Under these measures, the government will invest \$23.8 billion in the construction of municipal wastewater treat-

ment facilities by 2005 and \$51.8 billion in the water supply infrastructure by 2011.¹²⁰

The Four River Basin Project offers abundant opportunities related to large infrastructure projects. Its Nakdong River clean-up includes \$52.3 million for the construction of new sewage treatment plants, \$114.3 million for municipal wastewater treatment upgrades, and \$93.9 million for the rehabilitation of the sewerage network in the Taegu metropolitan area. The Youngsan River clean-up includes the construction of 37 new municipal wastewater treatment plants worth \$1.5 billion in the Kwangju metropolitan area. Under the Keum River clean-up, the government will finance the construction of 25 municipal and 10 industrial wastewater treatment plants. Finally, the Han River and Paldang Reservoir component will pay for the construction of sewage treatment facilities in rural areas (\$739 million) and industrial effluent treatment plants at local industrial estates (\$467 million). And these are just the main line items of the Four River Basin Project.¹²¹

The best market opportunities for U.S. water and wastewater equipment companies in South Korea include the export of advanced wastewater treatment processes and technologies, water recycling technology, and other areas of advanced technology.

Saudi Arabia

Population: 22 million (2000)

Urban population: 86 percent (2000)

GNP per capita: \$6,910 (1998)¹²²

GDP average annual growth rate 1.6 percent (1990–1998)

Water supply coverage (urban/rural): 100 percent/
64 percent (2000)

Sanitation coverage (urban/rural): 98 percent/
91 percent (2000)

Market Overview

Saudi Arabia is an arid country with severe climate conditions and an absence of natural fresh water resources as well as high population growth, rapid urbanization, industrialization, and agricultural development, all of which make water one of the country's most precious resources. The World Bank estimated that in 2000, Saudi

118. *FY 2001 Country Commercial Guide: Korea*, U.S. Foreign and Commercial Service and U.S. Department of State, 2000.

119. *Ibid.*

120. *Goals and Strategies for Providing Clean Water*, Ministry of Environment, Republic of Korea, 2000 (www.me.go.kr/english/sub/c1_1.htm).

121. *Rivers and Reservoirs Clean-Up Project in Korea*, U.S. Department of Commerce, International Trade Administration, 1999.

122. World Bank, *World Development Indicators* (Washington, D.C.: World Bank, 2000).

Arabia's water demand was five times the amount of available resources.¹²³

Desalination is the largest market segment in the country's water sector. Saudi Arabia relies on desalination to help meet the large demand for water and has become the world's largest producer of desalinated water, representing 30 percent of the world's capacity.

Desalinated water accounts for roughly 30 percent of Saudi Arabia's water supply. Currently, the country operates 25 desalination plants located at 15 major sites. Expenditures on desalination projects exceeded \$6 billion during the Sixth Plan (1995-2000). The total desalination capacity was expected to reach 800 million gallons per day by the end of the year 2000.¹²⁴

Saudi Arabia currently uses four major desalination processes: multi-stage flash evaporation, reverse osmosis, electrodialysis, and vapor compression. The evaporation process is used at more than 90 percent of the desalination plants.

In 1998, the total market for desalination equipment in Saudi Arabia amounted to \$357 million (the import market is 85 percent of the total) and was growing by 5 percent annually.¹²⁵

Saudi Arabia's low supply of water resources has also created a significant demand for wastewater treatment equipment and services. The total volume of wastewater generated in Saudi Arabia is 4 million tons per day, of which only 30 percent is treated.¹²⁶ It is estimated that 40 percent of municipal sewage could be recycled after treatment.

Regulatory and Institutional Framework

The principal agency involved in Saudi Arabia's environmental policy development is the Ministry of Defense and Aviation, which includes the Meteorological and Environmental Protection Agency. This agency is responsible for the design of environmental regulations and enforcing compliance. It also administers the Environmental Protection Standards (1989), including effluent standards and reporting requirements for industry. New plants must use the best available technology to control their effluents.

The agency's enforcement tool is to inform sectoral licensing agencies about environmental violations and

request the suspension of the violators' operating licenses. At the same time, its effectiveness as an enforcement agency is hampered by its position within the Ministry of Defense and Aviation (the country's largest and most powerful ministry), where environmental issues are not a priority.

The other two important national agencies in the water sector are the Ministry of Agriculture and Water and the Ministry of Municipal and Rural Development. Local governments are responsible for water resources management within their jurisdictions. However, they are typically more concerned about economic growth than resource conservation.

The Saline Water Conversion Corporation (SWCC) is the sole government entity responsible for desalination projects under construction and the expansion of desalination plants.

Privatization

The Saudi Arabian leadership has embarked on a comprehensive restructuring of the entire Saudi economy. Annual population growth rates of over 3 percent, coupled with depressed levels of foreign investment, have led the government to place strong new emphasis on private sector expansion. Although desalination as well as municipal water and wastewater treatment are presently entirely in the government's hands, this is likely to change in the near future. Given the fall in oil prices over the last decade and the corresponding drop in government revenues, the Saudi private sector is likely to gradually take over the construction, operation, and maintenance of water desalination projects on a BOT basis.

Trade and Investment Policy

Saudi Arabia's Council of Ministers recently approved a new Foreign Direct Investment Code, which establishes a framework for future legislative and regulatory activities aimed at enhancing the country's investment climate. It permits foreign investment in all but a few sectors and relaxes rules restricting foreign ownership of local businesses. The Council of Ministers also approved the establishment of the Saudi Arabian General Investment Authority to provide information and assistance to foreign investors.

Saudi Arabia is currently in the process of accession to the WTO. Once the country is admitted, its trade regime (currently plagued with regulatory and bureaucratic barriers) should become more transparent and accommodate to foreign businesses.

There are no restrictions on the import of water equipment into Saudi Arabia, although it is subject to a 12 per-

123. *The Water, Wastewater and Desalination Market in Saudi Arabia*, Canada, Department of Foreign Affairs and International Trade, 1997.

124. "Saudi Arabia: Desalination Industry," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1999.

125. *Ibid.*

126. *The Water, Wastewater and Desalination Market in Saudi Arabia*, Canada, Department of Foreign Affairs and International Trade, 1997.

cent tariff. Items manufactured locally are usually granted protection by raising the duty on similar imported items to 20 percent. All desalination equipment items and parts are exempted from any tariff duty if they are imported by or for plants run by the SWCC.

Although exporters are not required to appoint a local Saudi Arabian agent to sell to local companies, commercial regulations restrict importing and direct commercial marketing to wholly owned Saudi Arabian companies. In practice, local agents are a requirement. Agent/distributor relations are the responsibility of Saudi Arabia's Ministry of Commerce.

Direct marketing does not play a large role in Saudi Arabia. Many forms of Western advertising are unacceptable due to Islamic religious beliefs and practices. Instead, personal relationships between buyers and sellers play a much stronger role in export success.

U.S. Market Share and Competition

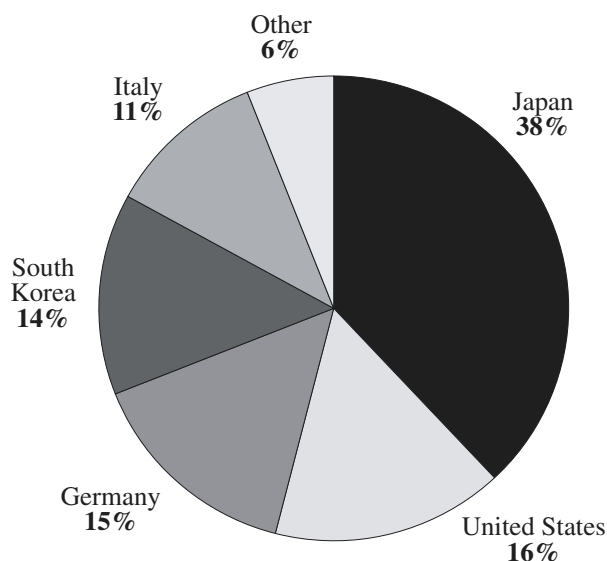
The demand for increased desalination capacity generates tough competition between Saudi firms and foreign companies from Japan, the United States, Korea, Germany, and Italy.

Local production of water equipment is minimal in Saudi Arabia, accounting for about \$5 million annually. For instance, about 98 percent of pumps, valves, and compressors are imported.¹²⁷ However, domestic firms receive preferential treatment and are becoming more competitive as they increase their involvement in the market.

Domestically, five plants manufacture filters, pipes, treatment chemicals, sterilization units, and membranes used mainly in reverse osmosis systems. Two Saudi companies, Al-Kawther and Metito, are the most advanced in the design, manufacture, and commissioning of reverse osmosis plants in the country.

More than 30 foreign companies are active in Saudi Arabia's desalination industry. In 1998, U.S. firms had a 16 percent share of the import market for desalination equipment (see Figure 4.5). U.S. assistance to the SWCC resulted in a better understanding of various desalination techniques used in the United States and how these techniques could be applicable to Saudi needs. U.S. companies dominate the Saudi market for reverse osmosis technology. U.S. firms have also supplied turbines, boilers, and generators for many multi-stage flash evaporation plants, although as of 1999, only two U.S. companies (Riley-Beaird and IHI) were prequalified with SWCC to supply multi-stage flash evaporation systems.

Figure 4.5. Import Market Shares for Desalination Equipment in Saudi Arabia



Source: Canada, Department of Foreign Affairs and International Trade, *The Water, Wastewater and Desalination Market in Saudi Arabia*, (Ottawa, 1997).

Both European and Japanese companies provide comprehensive work guarantees to the SWCC. U.S. firms, on the other hand, typically provide only manufacturer warranties for installed equipment, thereby reducing their competitiveness. Moreover, European and Japanese firms outnumber U.S. companies on the list of prequalified firms. Since many of the Saudi desalination plants were built by Japanese and European firms, most of the equipment and materials is sourced accordingly. Japanese, German, and Swiss consultants are major players in this industry, recommending specifications that favor companies from their countries.

The Saudi government follows a long-standing policy of encouraging locally made products and services. Therefore, a good way for new firms to enter the market is by establishing joint ventures with reputable Saudi companies. Since all desalination plants are built on a "turnkey basis," preference is usually given to prequalified foreign bidders having a business relationship with a Saudi company. Saudi regulations require any foreign company that obtains a contract with the government to appoint a Saudi service agent.

Market Opportunities

Desalination capacity development will remain a priority of the Saudi government for generations to come. Investment by the SWCC is expected to bring the production capacity to 1.3 billion gallons per day by the year

127. *The Water, Wastewater and Desalination Market in Saudi Arabia*, Canada, Department of Foreign Affairs and International Trade, 1997.

2010.¹²⁸ New desalination projects are directed toward reducing the cost of desalinated water through the optimization of chemical consumption and design and process improvements.

Given that most desalination plants in Saudi Arabia use the multi-stage flash evaporation system (SWCC officials believe that the process works very well and requires less maintenance than reverse osmosis systems), ample opportunities exist for sales and service of turbines, boilers, generators, and anti-scaling chemicals. Membranes, filters, and treatment chemicals will be also be in demand, especially at reverse osmosis installations. New technology that reduces both construction and production costs will also do well in the Saudi market. After-sale service and maintenance are usually key components of any turnkey contract with the SWCC.

As water becomes increasingly expensive in Saudi Arabia, Saudi industries seeking to improve their bottom line will also present opportunities for U.S. exporters of water conservation technologies.

Spain

Population: 40 million (2000)

Urban population: 78 percent (2000)

GNP per capita: \$14,000 (1999)

GDP average annual growth rate: 1.9 percent (1990–1998)

Water supply coverage (total): 91 percent (1998)¹²⁹

Sanitation coverage (total): 60 percent (1998)¹³⁰

Market Overview

In the 1990s, almost all Spanish municipalities with more than 20,000 inhabitants had a sewer system, but only 60 percent of all wastewater was treated. In 1997, 15 percent of households were served by primary treatment plants only, while 44 percent were connected to secondary municipal wastewater treatment plants.¹³¹

Although significant progress has been made over the past two decades in building new municipal sewage treatment plans, the installed capacity, particularly in rural areas, needs to be enhanced considerably. Industrial

wastewater treatment is often inadequate, with direct discharges polluting coastal waters, and indirect discharges damaging municipal sewerage infrastructure. The main water-polluting industries include chemical, power, steel and non-ferrous metallurgy, textiles, and construction.

Drinking water shortages are one of Spain's top environmental priorities. Water resources are severely depleted, and the deficit is made up through the overuse of aquifers. The problem is particularly acute in the Canary Islands, Balearic Region, Costa del Sol, Almería, Murcia, and Alicante regions. The growing water shortages create a demand for water desalination projects. Spain currently has the greatest desalination capacity in Europe, most of it represented by reverse osmosis technology.

The size of Spain's water and wastewater market is estimated at about \$4 billion annually. The Ministry of Environment estimates that the National Sewerage and Wastewater Treatment Plan (1995–2005) will require a total investment of \$14 billion, with more than 50 percent of this amount invested in new wastewater treatment plants and just over 40 percent used to expand sewerage networks. Spain's central government is expected to contribute about a quarter of this amount.¹³²

Regulatory and Institutional Framework

EU Directive 91/271 on wastewater treatment is the single most important regulation affecting investment in municipal sewerage infrastructure in Spain. According to the Directive, all communities with populations of more than 15,000 residents had to have fully functioning wastewater collection and treatment systems by the year 2000, and all smaller communities by 2005.

Spain's Water Law requires industrial and municipal polluters to pay effluent fees for direct discharges into surface waters. The Directorate-General of Hydraulic Works and Water Quality sets the charge structure and level (based on effluent parameters and rates per unit), which are applied by local drainage basin authorities.

Municipalities are responsible for drinking water supply and wastewater treatment. They also administer licenses for industrial discharges into municipal sewer systems. Indirect discharges are subject to service fees that sometimes take into account pollutant concentrations, but most often are volume-based. Fines for noncompliance with pretreatment standards range from \$10,000 to \$100,000.

128. "Saudi Arabia: Desalination Industry," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1999.

129. *Spain: Environmental Technologies*, Market Brief, Showcase Europe (www.sce.doc.gov), U.S. Department of Commerce, International Trade Administration, 1998.

130. Ibid.

131. *The Water, Wastewater and Desalination Market in Spain*, Canada, Department of Foreign Affairs and International Trade, 1998.

132. *Spain Environmental Technologies Export Market Plan*, U.S. Department of Commerce, International Trade Administration, 1998.

Privatization

Urban water and wastewater services in Spain have traditionally been provided by a mix of public and private institutions. In water supply, public entities deliver 72 percent of water, private enterprises 26 percent, and mixed ownership companies the remaining 2 percent. The role of the private sector has become more prominent in recent years with the influx of foreign water companies into the Spanish market. Private water management systems are more common in larger municipalities. About 87 percent of wastewater utilities are managed directly by municipalities, with private companies playing a much smaller role.

Trade and Investment Policy

Spanish import duties are equal to the Common Market External Tariff for non-EU goods, while there are no duties imposed on products imported from within the EU, giving EU suppliers a significant price advantage. In addition, water and wastewater equipment must be certified to meet EU environmental standards. There are no barriers to foreign investment in Spain.

U.S. Market Share and Competition

About 90 companies, of which 70 are public, control the water sector in Spain. Local production meets about three-quarters of the market demand.¹³³ Several Spanish companies manufacture water and wastewater equipment, producing mostly pumps, turbines, filters, and chemicals. However, specialized and high technology equipment is mostly imported. Imports also play an important role in the desalination market segment.

The primary competitors for U.S. companies are French and British firms. Vivendi and ONDEO have been particularly successful in Spain. Vivendi operates in Spain under the trade name Sociedad Mediterranea de Agua and has acquired a large share of private business in the sector. ONDEO is a partner in the Aguas de Barcelona consortium which has been expanding rapidly over the last several years.

Leading banking institutions, as well as former state-owned companies that were recently privatized, electric utilities, as well as other Spanish firms, have been organizing joint ventures and consortia to bid for water contracts. The best way for U.S. equipment suppliers to enter the Spanish market is to enter such joint ventures.

Market Opportunities

Market opportunities are expected to focus on the expansion of existing sewerage networks, with smaller communities connecting their sewer systems with larger municipalities in an effort to cut costs. Close to 3,200 wastewater treatment plants need upgrading to meet the requirements of the EU Directive, requiring an investment estimated at about \$1.4 billion until 2005.¹³⁴ Investment is expected to be concentrated around coastal areas and smaller inland population centers.

The following is a list of water and wastewater projects in Spain launched with financial support from the European Investment Bank in the last three years:

- Improvements to wastewater collection and treatment facilities in the Catalonia Region (\$90.1 million);
- Improvements to water supply infrastructure and forestry development in Castilla and León (\$33.5 million);
- Construction and extension of the wastewater treatment system on Balearic Islands (\$13.5 million);
- Improvements to wastewater collection and treatment facilities in the Valencia Region (\$42.0 million); and
- Improvements to road, drinking water supply, and wastewater collection and treatment infrastructure in the autonomous region of Extremadura (\$48.1 million).

The best sales prospects for U.S. water and wastewater equipment exporters include meters, reverse osmosis equipment for desalination plants, membranes, and control instrumentation.

Taiwan

Population: 22 million (2000)¹³⁵

Urban population: not available

GNP per capita: \$13,535 (1999)

GDP average annual growth rate: 7.6 percent (1990–1998)

Water supply coverage (urban/rural): not available

Sanitation coverage (urban/rural): 36 percent/
18 percent (2000)

133. *FY 2001 Country Commercial Guide: Spain*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

134. *The Water, Wastewater and Desalination Market in Spain*, Canada, Department of Foreign Affairs and International Trade, 1998.

135. All the presented general statistical data for Taiwan has been taken from the *Taiwan Monthly Bulletin of Statistics*, Taiwan's Directorate General of Budget, Accounting, and Statistics, 2001.

Market Overview

Taiwan's rivers serve as the primary source of drinking water for over three-quarters of the country's population. About 40 percent of surface waters in Taiwan are categorized by the government as polluted. Domestic sewage, industrial effluents, and livestock wastes account for 43 percent, 32 percent, and 25 percent of water pollution load, respectively.¹³⁶

The total water and wastewater market in Taiwan was estimated at \$1.9 billion in 1999, with imports responsible for nearly 75 percent of the supply (\$1.4 billion).¹³⁷

Regulatory and Institutional Framework

The Water Pollution Control Act and the Drinking Water Management Act form the legal foundation for water management in Taiwan. Under the Water Pollution Control Act, every industrial facility is required to submit a water pollution control plan to the Taiwan Environmental Protection Agency in order to obtain a mandatory discharge permit. Municipal wastewater treatment plants are also required to comply with effluent standards. Effluent standards are based on best available technology and were tightened significantly in 1997. At the same time, Taiwan strengthened its environmental monitoring and inspection system to ensure stricter enforcement. Penalties for violations are significant, up to \$30,000 in fines and imprisonment.

In 1998, Taiwan's Environmental Protection Agency introduced wastewater discharge fees for industries, public wastewater utilities, and households. The industrial effluent fees are based on chemical oxygen demand, suspended solids, and heavy metal content. The fees are being phased in through July 2002.¹³⁸

The government-owned Taiwan Water Supply Corporation is responsible for large infrastructure development projects in the country. Local governments operate water and wastewater utilities.

Privatization

Taiwan's Law for Promotion of Private Participation in Public Infrastructure Projects (also known as the "BOT Law") was promulgated in February 2000. The law provides the basic legal framework for private-sector enti-

ties to participate in public infrastructure projects in Taiwan and provides incentives for private participation. The government is currently designing the first BOT water infrastructure projects.¹³⁹

Trade and Investment Policy

There is no import tariff on environmental equipment in Taiwan. Moreover, Taiwanese companies buying such equipment are eligible for investment credits and low-interest loans. Taiwan has long encouraged and facilitated direct foreign investment. Regulations affecting foreign-invested enterprises are generally transparent and non-discriminatory.

However, Taiwan's public procurement practices constitute a significant trade barrier. There is often overt discrimination between local and foreign bidders on government contracts. Municipal governments in particular have been notably arbitrary in dealing with foreign contractors. Perhaps the most consistent complaint made by U.S. companies involves unfair terms and conditions required by the particular procuring entity. A new government procurement law was enacted in 1999 but will not be fully applicable to foreign bidders until Taiwan's expected accession to WTO.¹⁴⁰

U.S. Market Share and Competition

Japan dominates the import market for water and wastewater technologies with a 34 percent market share, followed by the United States with 28 percent and Germany with 14 percent (see Figure 4.6). Japanese firms have historically done very well in this market due to their strong reputation for after-sale service, high quality, and low price. The geographic proximity and cultural similarity add to the advantage of Japanese products. To be successful, U.S. companies need to convince Taiwanese end-users of their ability to offer top quality at a competitive price, while providing reliable local customer service. The establishment of a partnership with a local agent is seen as the most effective way to enter the Taiwanese market.

Local firms are expected to play a larger role in the future, as they gain knowledge and technical expertise in the field. There are presently about 300 water and wastewater equipment manufacturers in Taiwan. Most of them are small and medium-sized companies producing

136. "Taiwan: Water Pollution Prevention Equipment," *Industry Sector Analysis*, U.S. and Foreign Commercial Service and U.S. Department of State, 1999.

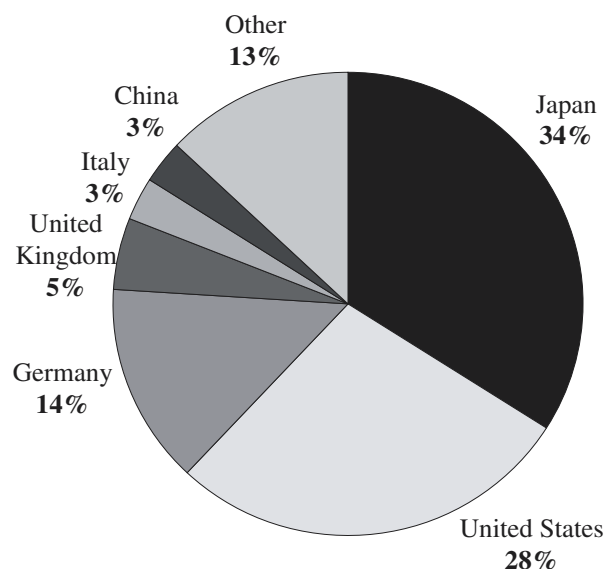
137. Ibid.

138. *Water Pollution Control Fees in Taiwan*, U.S. Department of Commerce, International Trade Administration, 1998.

139. "Taiwan Law for Promotion of Private Participation," *International Market Insight*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

140. *Taiwan FY 2001 Country Commercial Guide*, U.S. and Foreign Commercial Service and U.S. Department of State, 2000.

Figure 4.6. Import Market Shares for Water and Wastewater Equipment in Taiwan



Source: U.S. and Foreign Commercial Service and U.S. Department of State, *Industry Sector Analysis; Taiwan: Water Pollution Prevention Equipment* (Washington, D.C., 1999).

technologically unsophisticated equipment, including pumps, blowers, valves, and simple filters.

Market Opportunities

The Taiwanese government is currently implementing an action plan to improve the water quality of Taiwan's five major rivers (Five Rivers Project). Over \$1 billion will be spent for the construction of 12 municipal wastewater collection and treatment systems between 1999 and 2006. Size of the plants varies significantly between projects, ranging from 3,000 cubic meters per day to 120,000 cubic meters per day.

Eighteen water treatment plants will be upgraded in the near future, eight of them under the Five Rivers Project. The largest water supply project is the \$40 million water treatment plant expansion in Kaohsiung.

The best prospects for U.S. suppliers include advanced wastewater treatment and recycling technologies, advance oxidation equipment, sophisticated membranes, heavy metal recovery equipment, etc.

United Kingdom

Population: 59 million (2000)
 Urban population: 89 percent (2000)
 GNP per capita: \$22,640 (1999)

GDP average annual growth rate: 2.2 percent (1990–1998)
 Water supply coverage (urban/rural): 100 percent/
 100 percent (2000)
 Sanitation coverage (urban/rural): 100 percent/
 100 percent (2000)

Market Overview

Over the last 10 years, the U.K. water and wastewater market has been driven by two main factors: the requirement placed upon the privatized utilities (see the Privatization section) to invest heavily in the delivery of water and wastewater services; and the impact of increasingly stringent EU water quality regulations.

British water and wastewater companies spend about \$5.5 billion every year on improving water supply and sewerage services.¹⁴¹ The annual market for water and wastewater equipment was estimated at \$4 billion in 2000, including \$1.2 billion in drinking water supply, \$2 billion in municipal and industrial wastewater treatment, and \$0.8 billion in water cleanup. The market is growing at about 4 percent per year.¹⁴²

Regulatory and Institutional Framework

Britain's water regulations reflect the provisions of the main EU Directives in this sector. The Drinking Water Directive (1989) sets drinking water quality standards; the Bathing Water Directive (1991) establishes coastal water quality standards, and the Urban Wastewater Directive (1994) stipulates minimum standards for sewerage systems and sewage treatment.

The water and wastewater industry in the United Kingdom is regulated by three main bodies: the Environment Agency, the Office of Water Services, and the Drinking Water Inspectorate. The Environment Agency and the Drinking Water Inspectorate are subordinated to the Department of the Environment, Transport, and the Regions, whose Water and Land Directorate oversees all water-related aspects of environmental policy.

In 1996, the Environment Agency took over the functions of its predecessors, the National Rivers Authority, Her Majesty's Inspectorate of Pollution, Waste Regulation Authorities and some sections of the Department of the Environment. It issues and enforces permits for both

141. *The Environmental Products and Services Market in the United Kingdom*, Canada, Department of Foreign Affairs and International Trade (Ottawa, 2000).

142. *The U.K. Environmental Technology Market*, U.S. Department of Commerce, International Trade Administration (Washington, D.C., 2000).

water abstractions and wastewater discharges, and charges respective fees. It also has monitoring and inspection responsibilities.

The Office of Water Services is an independent economic regulator with a duty to ensure that the water companies carry out and can finance their functions properly. It protects the interests of consumers, particularly where tariffs are concerned. It is also charged with facilitating competition and promoting the efficient use of water. The Office sets price caps for each company (thereby mandating efficiency savings) for five-year intervals.

The Drinking Water Inspectorate conducts inspections of water companies to ensure their compliance with the drinking water and other applicable technology standards. The Inspectorate investigates incidents that affect water quality and approves chemicals and materials used in treating water. New, more stringent drinking water quality standards were promulgated in 2000, with compliance required by the end of 2003.

Privatization

Under the Water Act of 1989, the United Kingdom restructured its water industry, privatizing all water and wastewater operations in England and Wales. Major driving forces behind the government's privatization program were the lack of separation between the regulator and the regulated entity, apparent inefficiencies, and the enormous investment needed to improve service and bring the water and wastewater systems up to EU environmental standards.

Ten integrated water and wastewater companies replaced 10 regional water authorities that had existed since 1974. After the restructuring, 29 smaller statutory water companies (responsible for water supply only) continued to exist, although that number is now down to 17 due to mergers. Some companies are now owned by foreign firms, including France's Vivendi (which owns Three Valleys Water, North Surrey Water, and two other utilities) and ONDEO (which owns Northumbrian Water and Essex and Suffolk Water). The U.S. firm Azurix owns Wessex Water. Many U.K. water companies have diversified into other utility services, and several (for example, Thames Water, Severn Trent, Anglian Water) have moved into the global market for water and wastewater services.

Trade and Investment Policy

The United Kingdom is one country where U.S. exporters face very few real problems in doing business. The hurdles common in other countries, including dif-

ferences in language, culture, legal and business practices, are largely absent.

Most products (including machinery, electrical, and electronic equipment) imported into the European Union must comply with the relevant EU standards and demonstrate this conformity by bearing the CE Mark. The CE Mark is a requirement for affected products regardless of their origin. Moreover, it removes the need to design products to comply with individual national sets of standards. An EU common external tariff applies to all non-EU imports.

Procurement by the United Kingdom's water and wastewater companies is carried out in a number of ways, the most important of which are:

- companies use their own lists of approved suppliers;
- companies use commercial lists of pre-qualified/approved suppliers; or,
- for large contracts, it may be necessary to follow EU procurement procedures.

U.S. Market Share and Competition

There is strong competition in the British water and wastewater market for almost every product and service, with no one company enjoying a dominant position. The British industry is very strong in municipal water and wastewater treatment, monitoring, and testing. There are close links between manufacturers, consultants, and the water and wastewater companies. At the same time, due to privatization and the United Kingdom's EU membership, the competition includes a large and growing number of foreign suppliers. French, German, U.S., and Japanese companies are the main foreign players in this market, followed by Canadian and Australian firms. Imports account for about 55 percent of the total market size.

U.S. companies enjoy a 25 percent import market share. Demand for most U.S. water and wastewater technologies is strong, with growth rates of 5 percent to 6 percent per year expected in the near term.¹⁴³ The experience of foreign companies active in the United Kingdom suggests that the best way to enter this market is to work with a local partner rather than try to establish a local presence.¹⁴⁴

143. International Business Development Office, State of Utah, 2000 (www.utahtrade.com/KnowledgeCenter/World/countries/Uk/reports/uk-leading.htm).

144. *The Environmental Products and Services Market in the United Kingdom*, Canada, Department of Foreign Affairs and International Trade (Ottawa, 2000).

Market Opportunities

British water and wastewater companies plan to invest \$20 billion through 2004 to improve the quality and efficiency of their services. The ambitious 1999-2004 water quality improvement program includes:

- Municipal wastewater treatment improvements covering 15 million customers;
- Drinking water treatment improvements for 30 million customers to reduce the risk from cryptosporidium;
- Installation of treatment at water sources supplying 17 million customers to reduce the amount of dissolved lead from plumbing;

- Rehabilitation of some 22,000 kilometers of water distribution mains to reduce water losses;
- Installation of secondary treatment for all coastal discharges in towns with a population of over 2,000 residents.¹⁴⁵

This massive program will present many opportunities for U.S. suppliers of water and wastewater technologies and services. Aeration, screening and sludge dewatering equipment, phosphorus and heavy metal removal, and anaerobic digestion are the products and technologies that offer good prospects for future growth.

145. Ibid.

Appendix A

Major International Water and Wastewater Projects

Country	Funding Agency/Source	Project Title	Project Components			Project Financing (millions of dollars)		Project Duration Status	Executing Agency
			Municipal Water Supply and Treatment	Municipal Sewage and Sanitation	Industrial Wastewater Treatment	Total Proj. Amt.	Loan/Grant Amt.		
Albania	WB	Water Supply and Urgent Rehabilitation Project	●			n.a.	10	2000–?	World Bank Water PIU in Durres and Support
Angola	WB	Luanda Water Supply Project	●			n.a.	20	under preparation	n.a.
	WB	Urban Water Supply and Sanitation Project	●	●		n.a.	20	under preparation	National Directorate of Water
Argentina	WB	Pollution Management Project			●	n.a.	18	1998–2003	Secretariat for the Environment
	WB	Water Sector Reform Project		●		n.a.	30	1999–?	Secretariat of Public Works
	IDB	Program in Support of Reform of the Water Supply and Sanitation Sector	●	●		571	250	1998–2003	National Board of Water and Sanitation Works
Armenia	WB	Municipal Development Project	●	●		n.a.	30	1998–?	Municipal governments
	WB	Municipal Water and Wastewater Project	●	●		n.a.	20	under preparation	Armenian water & sewerage companies
Bangladesh	WB	Dhaka Water Supply Project	●			n.a.	80	1996–?	DWASA
	WB	School and Community Sanitation Project		●		n.a.	75	under preparation	Department of Public Health and Engineering
Bolivia	IDB	Basic Sanitation Program for Small Municipalities		●		56	40	1999–?	Ministry of Housing and Basic Services
Bosnia–Herzegovina	WB	Mostar Water and Sewerage Project	●	●		n.a.	12	2000–?	Mostar Water Supply and Sewerage Utility
Brazil	IDB	Guaiba Watershed Environmental Management Program		●	●	221	132	1993–?	Secretariat of Planning and Administration
	IDB	Tiete River Cleanup Project, Stage II		●	●	400	2000	1999–2002	Basic Sanitation Company of the State of Sao Paulo, State Ministry of Water Resources, Sanitation and Works, State Environmental Sanitation Company

Country	Funding Agency/Source	Project Title	Project Components			Project Financing (millions of dollars)		Project Duration Status	Executing Agency
			Municipal Water Supply and Treatment	Municipal Sewage and Sanitation	Industrial Wastewater Treatment	Total Proj. Amt.	Loan/Grant Amt.		
Brazil	IDB	Federal District Sanitation Program	●	●		260	130	2000–2005	Department of Infrastructure and Works of the federal district government
	IDB	Basic Sanitation Program for the Guanabara Bay Basin	● ●	● ●	● ●	793 793	350 350	1993–? 1993–?	State water company State water company
	IDB	São Paulo Drainage Program, Stage II		●		544	302	1994–?	n.a.
	WB	Small Localities Water and Sanitation Project	●	●		n.a.	150	under preparation	SEPURB/Casa Civil
	WB	São Paulo Water Quality and Pollution Control Program		●		n.a.	245	1992–2002	Secretariats of States
	WB	Federal Water Resources Management Project	●			n.a.	198	1998–2003	Secretariat of Water Resources
	WB	Bahia Water Resources Management	●		●	n.a.	51	1997–2002	SRHSH
Bulgaria	EBRD	Sofia Water System Concession	●	●		91	32	2000–?	Sofijska Voda AD
Burkina Faso	WB	Water Supply Project (01)	●			n.a.	70	under preparation	ONEA
Cambodia	WB	Urban Water Supply Project	●			n.a.	31	1998–?	Ministry of Industry, Mines and Energy
China	ADB	Provincial Towns Improvement Project	●	●		26	20	1999–2005	Ministry of Industry, Mines and Energy
	ADB	Suzhou Creek Rehabilitation		●	●	916	300	1999–2010	Suzhou Creek Rehabilitation and Construction Co., Ltd.
	ADB	Tianjin Wastewater Treatment and Water Resources Protection		●		345	130	1999–2005	n.a.
	ADB	Fuzhou Water Supply and Wastewater Treatment	●	●		192	102	1995–2002	Fuzhou ADB Project Office
	ADB	Zhejiang–Shanxi Water Supply Project	●			518	100	1997–?	Shanxi Economic Development Corporation
	WB	Hebei Urban Environment Project	●	●	●	n.a.	150	2000–?	Hebei Provincial Government
	WB	Chongqing Urban Environment Project	●	●		n.a.	200	2000–?	Chongqing Municipal Government
China	WB	National Rural Water Supply Project	●			n.a.	70	1997–?	National Public Health Commission
	ADB	Mudanjiang Water Supply	●			185	90	1997–?	Mudanjiang Linhai General Water Supply Company

		WB	Liao River Basin Project		●	●	n.a.	200	under preparation	Liaoning Province
		WB	Beijing Environment Project (02)		●	●	n.a.	349	2000–2006	Beijing Municipal Government
		WB	Sichuan Urban Environment Project		●	●	n.a.	152	1999–2006	Sichuan Provincial and Municipal Government
		WB	Guangxi Urban Environment Project		●	●	n.a.	92	1998–2004	Nanning and Guilin
		WB	Shandong Environment Project		●	●	n.a.	95	1997–2003	Shandong Urban and Rural Const. Com / Env.PR
		WB	Yunnan Environment Project		●	●	n.a.	150	1996–2002	Municipal governments
		WB	Chongqing Industrial Pollution Control and Reform Project			●	n.a.	170	1996–2002	Chongqing Municipality
	Colombia	WB	Cartegena Water Supply, Sewerage and Environ. Management Project	●	●	●	n.a.	85	1999–?	Aguas de Barcelona
		WB	Water Sector Reform Assistance Project	●			n.a.	60	under preparation	The Ministry of Economic Development
	Croatia	IDB	Medelín River Sanitation Program		●		66	40	2000–?	Medellín Public Utility
		WB	Municipal Environmental Infrastructure Project	●	●		n.a.	30	1998–?	Eko and Split Water Companies
		EBRD	Rijeka Sewerage and Service Project		●		11	7	1999–?	City of Rijeka and Rijeka Water and Sewerage Company
	Dominican Republic	WB	Wastewater Disposal in Tourism Centers Project	●	●		n.a.	5	2000–?	Technical Secretariat of the Presidency
	East Timor	ADB	Water and Sanitation Sector Rehabilitation Project	●	●		10	10	2000–?	United Nations Transitional Administration
	Ecuador	WB	Guayaquil Water and Sewerage Management Project	●	●		n.a.	35	under preparation	n.a.
	Egypt	WB	Rural and Small City Water Project	●	●		n.a.	32	2000–?	MIDUVI/SSA
		WB	Pollution Abatement Project			●	n.a.	35	1997–2003	Egypt Environmental Affairs Agency
		USAID	Secondary Cities Development	●	●		n.a.	215	1994 –2002	Governorates (provincial governments)
		USAID	Alexandria Wastewater System, Expansion II		●		n.a.	90	1998–2002	Alexandria General Organization for Sanitary Drainage
			Alexandria Drinking Water Initiative	●			n.a.	200	1998–2002	Alexandria Water General Authority
		USAID	Egypt Utilities Management Program	●	●		n.a.	215	1997–2004	Economic General Authorities for Water Supply and Sanitary Drainage
	Ethiopia	WB	Water Supply Development and Rehabilitation Project	●			n.a.	36	under preparation	AWSA, WSSA
	Republic of Fiji	ADB	Suva Nausori Water	●	●		55	42	under preparation	Ministry of Communication Works and Energy

Country	Funding Agency/ Source	Project Title	Project Components			Project Financing (millions of dollars)		Project Duration Status	Executing Agency
			Municipal Water Supply and Treatment	Municipal Sewage and Sanitation	Industrial Wastewater Treatment	Total Proj. Amt.	Loan/ Grant Amt.		
Georgia	WB	Tbilisi Water Supply and Sanitation Project	●	●		n.a.	25	under preparation	Tbilisi Water Utility
	WB	Integrated Coastal Management Project			●	n.a.	4	1998–2004	Ministry of Environment
Guatemala	IDB	Rural Water Investment Program	●	●		63	50	under preparation	INFOM (Municipal Promotion Institute)
	IDB	Program for Sanitation and Sustainable Productive Management of the Amatitlan Lake Watershed	●	●		40	8	1998–2003	Authority for the Sustainable Management of Lake Amatitlan
Guinea	WB	Water Supply and Sanitation Project	●	●		n.a.	25	under preparation	n.a.
Honduras	IDB	Supplement to Potable Water and Sanitation Investment Program	●	●		22	20	2000–?	Ministry of Finance
Hungary	WB	Municipal Wastewater Project		●		n.a.	32	1999–?	Municipalities
India	WB	Industrial Pollution Prevention Project			●	n.a.	168	1994–2002	Ministry of Environment
	WB	Madras Water Supply and Sanitation Project	●			n.a.	105	under preparation	Metrowater and Chennai Municipal Corporation
	WB	Karnataka Rural Water Supply and Environmental Sanitation Project	●	●		n.a.	150	under preparation	Government of Karnataka and Tamil Nadu
	WB	Rural Water Supply and Environmental Sanitation Project	●	●		n.a.	66	2000–2006	Government of Kerala
	WB	Uttar Pradesh Rural Water Supply and Environmental Sanitation Project	●	●		n.a.	60	1996–2002	n.a.
	WB	Bombay Sewage Disposal Project		●		n.a.	192	1995–2002	Municipal Corp. of Bombay
	WB	Madras Water Supply Project	●			n.a.	276	1995–2002	Metrowater
India	ADB	Karnataka Urban Development and Coastal Environmental Management Project	●	●		251	175	1999–2004	Karnataka Urban Infrastructure Development and Financing Corporation
	ADB	Rajasthan Urban Infrastructure Development	●	●		362	250	1998–2004	Urban Development Department
Indonesia	ADB	Water Supply and Sanitation Sector	●	●		100	100	expected 2001	Directorate General of Urban and Rural Development

		ADB	Capacity Building for Water Supply Enterprises for Water Loss Reduction Sector Projects	●		119	66	1997–?	Directorate General of Public Administration and Regional Autonomy
	Iran	WB	Tehran Sewerage Project		●	n.a.	145	2000–2004	Tehran Sewerage Company
	Jamaica	IDB	Kingston Water and Sanitation	●	●	50	35	under preparation	National Water Commission
	Jordan	WB	Amman Water and Sanitation Management Project	●		n.a.	55	1999–2004	Water Authority of Jordan
	Kazakhstan	WB	Atyrau Pilot Water Supply and Sanitation Project	●	●	n.a.	16	1999–?	Atyrau Oblast Government
		WB	Pilot Water Supply Project	●		n.a.	7	1996–?	State Committee for Water Resources
		EBRD	Almaty Potable Water and Sewerage Project	●	●	40	6	2001–?	Almaty Sui
		WB	Atyrau Pilot Water Supply and Sanitation Project	●	●	n.a.	17	1999–2004	Atyrau Oblast Akimat
		WB	Environmental Management and Rehabilitation Project			52	42	under preparation	Ministry of Natural Resources and Environment
	Kenya	WB	Lake Victoria Environmental Management Project		●	n.a.	13	1996–2002	Ministry of Environment and Natural Resources
	Kiribati	ADB	Sanitation, Public Health, and Environment Improvement	●	●	13	10	1998–?	Ministry of Finance and Economic Planning
	Kyrgyz Republic	ADB	Community-Based Infrastructure Services Sector	●	●	45	36	2000–2005	Ministry of Agriculture and Water Resources
		WB	Rural Water and Sanitation Project	●	●	n.a.	20	under preparation	Ministry of Agriculture and Water Resources
	Laos	ADB	Water Supply and Sanitation Sector	●	●	25	20	1999–?	Ministry of Communication, Transport, Post and Construction
	Lebanon	WB	Greater Beirut Water Supply	●	●	n.a.	65	under preparation	Council for Development and Reconstruction
	Lesotho	WB	Highlands Water Project			n.a.	45	1998–2004	LHDA
	Macedonia	WB	Water Supply and Sewerage Project	●	●	n.a.	32	under preparation	Water Companies and the Ministry of Urbanism
	Madagascar	WB	Rural Water Supply and Sanitation Pilot Project	●	●	n.a.	17	1997–2003	Ministry of Energy and Mines
	Mauritius	WB	Environmental Sewerage and Sanitation Project		●	n.a.	12	1998–2003	WWA
	Mexico	NADB	Acuna, Coahuila Comprehensive Sanitation Project		●	80	17	2000–?	Municipal Water and Wastewater Utility
		NADB	Juarez, Chihuahua, North and South Wastewater Treatment Plants Project		●	31	5	1997–?	Municipal Water and Wastewater Utilities

Country	Funding Agency/ Source	Project Title	Project Components			Project Financing (millions of dollars)		Project Duration Status	Executing Agency
			Municipal Water Supply and Treatment	Municipal Sewage and Sanitation	Industrial Wastewater Treatment	Total Proj. Amt.	Loan/ Grant Amt.		
	NADB	Naco, Sonora, Water Supply and Wastewater Collection and Treatment System	●	●		2	1	1996–?	Municipal Water and Wastewater Utilities
	NADB	Nogales, Sonora, Water Supply and Distribution Project	●			39	9	1996–?	Municipal Water and Wastewater Utilities
	NADB	Puerto Palomas, Chihuahua, Improvement to Wastewater Collection and Treatment Systems		●		5	2	2000–?	Municipal Water and Wastewater Utilities
	NADB	Region Cinco Manantiales, Coahuila, Paper Recycling and Wastewater Treatment Project		●		18	7	2000–?	Industrial Papelera Solar
	NADB	Reynosa, Tamaulipas Comprehensive Sanitation Project		●		83	8	1998–?	n.a.
	NADB	San Luis Colorado, Sonora (construction of a wastewater treatment plant and rehabilitation of the wastewater collection system)		●		14	6	2000–?	Organismo Operador Municipal de Agua Potable, Alcantarillado y Saneamiento de San Lui Rio Colorado
	NADB	Piedras Negras, Coahuila, Comprehensive Sanitation Project		●		57	17		Sistema Municipal de Aguas y Sanemiento de Piedras Negras
	NADB	Ensenada Baja California, Wastewater Treatment Plant		●		8	None	1995–?	n.a.
	NADB	Matamoros, Tamaulipas, FINSA Industrial Park			●	1	None	1996–?	n.a.
	NADB	Mexicali, Baja California, Sanitation Program for the City of Mexicali		●		57	21	2000–?	State Water Commission
	NADB	Tecate, Baja California, Improvement and Expansion of the Water and Wastewater System	●	●		8	4	2000–?	Tecate State Public Services Commission
	NADB	Tijuana, Baja California, Sewage Treatment Plant Rehabilitation and Expansion		●		20	3	1997–?	n.a.
Mongolia	WB	Ulan Bator Services Improvement Project	●			n.a.	17	1997–?	n.a.

Morocco	WB	Rural Water Supply and Sanitation Project	●	●	n.a.	10	1997–?	National Office of Potable Water
Mozambique	WB	National Water Development Project			n.a.	35	1998–?	Ministry of Public Works and Housing
Nepal	ADB	Melamchi Water Supply Project	●		464	120	2000–?	Ministry of Planning and Publications
	ADB	Small Towns Water Supply and Sanitation Sector	●	●	54	35	2000–?	Ministry of Physical Planning and Works
	WB	Rural Water Supply and Sanitation Project	●	●	n.a.	18	1996–2002	Rural Water Supply and Sanitation Fund
Nicaragua	IDB	Lake Managua and City of Managua Environmental Improvement Program, Stage I		●	47	15	1996–?	INAA
Niger	WB	Niger State Water Supply and Sanitation Sector Study Project	●	●	n.a.	46	under preparation	Ministry of Water Resources
Nigeria	WB	Small Towns Water Supply and Sanitation Program Pilot Project	●	●	n.a.	5	2000–?	Ministry of Water Resources and Rural Development
	WB	Urban Water Sector Reform Project	●		n.a.	250	under preparation	Federal Ministry of Water Resources
Pakistan	ADB	Korangi Wastewater Management		●	101	70	1997–?	Government of Sindh Karachi Water and Sewerage Board
	WB	Karachi Water Supply and Sanitation Project	●	●	n.a.	92	1993–?	KWSB/KMC
Papua New Guinea	ADB	Provincial Towns Water Supply and Sanitation	●	●	15	25	2000–?	Papua New Guinea Water Board
Paraguay	WB	Rural Water Supply and Sanitation Project	●		n.a.	40	1997–2003	Senasa
Philippines	WB	Asunción Sewerage Project		●	n.a.	47	1995–2003	Corposana
	WB	Water Districts Development Project		●	n.a.	57	1997–2004	Local government
	WB	Local Government Units Urban and Sanitation Project	●	●	n.a.	86	under preparation	n.a.
	WB	Manila Sewerage Project		●	n.a.	57	1996–2003	MWSS
	ADB	Mindanao Basic Urban Service Sector	●	●	71	35	1997–2002	Land Bank of the Philippines
	ADB	Subic Bay Area Municipal Development Project	●		37	22	1997–2002	Subic Bay Metropolitan Authority
Poland	EBRD	Krakov Plaszow II Wastewater Treatment Plant Modernisation Project		●	74	20	2000–?	Krakov Water Supply and Waste Water Treatment Company
	WB	Bielsko Biala Water and Wastewater Project	●	●	n.a.	22	1996–2003	n.a.
	EBRD	Bydgoszcz Water Supply and Sewerage Services Development Program	●	●	62	23	1999–?	Water Supply and Sewerage Company of Bydgoszcz

Country	Funding Agency/Source	Project Title	Project Components			Project Financing (millions of dollars)		Project Duration Status	Executing Agency
			Municipal Water Supply and Treatment	Municipal Sewage and Sanitation	Industrial Wastewater Treatment	Total Proj. Amt.	Loan/Grant Amt.		
Russia	WB	Water Supply and Sanitation	●	●		n.a.	123	2000–2006	Municipal Water and Wastewater Enterprise
	WB	Community Social Infrastructure Project	●	●		n.a.	200	1996–2002	Ministry of Nationalities and Federal Affairs
	WB	Municipal Water and Wastewater Project	●	●	●	n.a.	122	2000–2006	Municipal Water and Wastewater Enterprise
Russia	EBRD	Yaroslav Municipal Water Services Development Program	●			18	14	under preparation	Yaroslavl Water Utility
	EBRD	Kaliningrad Water and Environmental Services Project	●			63	18	1999–?	Kaliningrad Vodokanal
Rwanda	WB	Rural Water and Sanitation Project	●	●		n.a.	20	2000–?	MINERENA/CDC
Senegal	WB	Long–Term Water Supply Project	●			n.a.	125	under preparation	n.a.
Sierra Leone	WB	Urban Water Supply Project	●			n.a.	36	1995–2003	Guma Valley Water Co.
Sri Lanka	WB	Urban Water Supply and Sanitation Project	●	●		n.a.	20	under preparation	Ministry of Urban Development Construction
	WB	Environmental Action Plan			●	n.a.	15	1997–2002	MTEWA
Tajikistan	WB	Dushanbe Water Supply Project	●			n.a.	15	under preparation	Dushanbe Vodokanal (DVK)
Tanzania	WB	Rural Water Supply and Sanitation Project	●	●		n.a.	15	under preparation	Ministry of Water
	WB	Dar–es–Salam Water Supply and Sanitation Project	●	●		n.a.	45	under preparation	Ministry of Water, Dar es Salaam Water Supply and Sewerage Authority
	WB	Lake Victoria Environmental Management Project		●	●	n.a.	10	1996–2002	Vice President’s Office
Thailand	ADB	Samut Prakarn Wastewater Management		●		671	230	1998–?	Pollution Control Department
	ADB	Northeast Region Water Supply	●			100	5	n.a.	Provincial Waterworks Authority
Tunisia	WB	Greater Tunis Sewerage and Reuse Project		●		n.a.	60	1997–2004	National Office of Sanitation/Ministry of Agriculture
	WB	Water Supply and Sewerage Project	●	●		n.a.	58	1994–2002	Sonede/National Office of Sanitation

Turkey	WB	Antalya Water Supply and Sanitation Project	●	●	n.a.	130	1995–2003	Antalya Water Supply and Sewerage Authority
Uganda	WB	Lake Victoria Environmental Management Project		●	●	n.a.	12	1996–2002 Ministry of Natural Resources
Ukraine	WB	Municipal Water and Wastewater Project				n.a.	24	under preparation Lviv Vodokanal
Uruguay	WB	Water Sector Modernization and Rehabilitation Project	●	●	n.a.	27	2000–2004	State Water Utility
Uzbekistan	WB	Water Supply, Sanitation, and Health Project	●		n.a.	30	1997–2005	State Committee for Monitoring and Statistics
	WB	Samarkand and Bukhara Water Supply and Sanitation Project	●	●	n.a.	41	under preparation	Bukhara and Samarkand Water Utility
Vietnam	WB	Water Supply Project	●		n.a.	99	1997–2002	Ministry of Agriculture
	WB	Three Cities Sanitation Project		●	n.a.	80	1999–2005	Municipal water utilities
Yemen	WB	Municipal Water Project			n.a.	90	under preparation	Ministry of Electricity and Water
	WB	Sana's Basin Water Management Project			n.a.	50	under preparation	National Water and Sanitation Authority

Note: For explanation of acronyms used in this table, see the list of acronyms on page iv.

Appendix B

Government and Industry Contact List

U.S. Government Agencies

U.S. Agency for International Development

Information Center

1300 Pennsylvania Ave., NW
Ronald Reagan Building
Washington, DC 20523-0016
Tel: (202) 712-4810
Fax: (202) 216-3524
Web site: www.info.usaid.gov

Africa Bureau

USAID/AFR, Room 4.08
Tel: (202) 712-0500
Fax: (202) 216-3008
Web site: www.info.usaid.gov/regions/afr/

Asia and Near East Bureau

USAID/ANE, Room 4.09
Tel: (202) 712-0200
Fax: (202) 216-3386
Web site: www.info.usaid.gov/regions/ane/

Europe and Eurasia Bureau

USAID/ENE, Room 5.06
Tel: (202) 712-0290
Fax: (202) 216-3057
Web site: www.info.usaid.gov/regions/europe_eurasia/

Latin America and the Caribbean Bureau

USAID/LAC, Room 5.09
Tel: (202) 712-4800
Fax: (202) 216-3012
Web site: www.info.usaid.gov/regions/lac/

Eurasian American Partnership for Environmentally Sustainable Economies (EcoLinks)

U.S. Regional Office
1400 K St., NW, Suite 650
Washington, DC 20005
Tel: (202) 326-7798
Fax: (202) 326-7709
E-mail: plai@iie.org
Web site: www.ecolinks.org

Global Technology Network (GTN)

1133 20th St. NW, Suite 600
Washington, DC 20036
Tel: (202) 955-7473
Fax: (202) 785-8489
E-mail: usgtn@usgtn.org
Web site: www.usgtn.org/

U.S.-Asia Environmental Partnership (US-AEP)

1720 I St. NW, Suite 700
Washington, DC 20006
Tel: (202) 835-0333
Fax: (202) 825-0366
E-mail: usasia@usaep.org
Web site: www.usaep.org

US-AEP Technology Representation Offices

Web site: www.usaep.org/contacts.htm#technologyrepresentatives

Environmental Technology Network for Asia (ETNA)

1720 Eye St. NW, Suite 600
Washington, DC 20006
Tel: (800) 818-9911
Fax: (202) 835-8358
E-mail: tyoder@usaep.org
Web site: www.usaep.org/ouractiv/etna.htm

U.S. Department of Commerce

International Trade Administration

14th St. and Constitution Ave., NW
Washington DC 20230
Tel: (800) 872-8723 or (202) 482-3809
Fax: (202) 482-5819
Web site: www.ita.doc.gov

Bureau of Export Administration

Tel: (202) 482-2721
Fax: (202) 482-2421
Web site: www.bxa.doc.gov/factsheets/ExporterAssistance.html

Export Assistance Centers

U.S. Department of Commerce
International Trade Administration
Room 3810
14th St. and Constitution Ave., NW
Washington, DC 20230
Tel: (202) 482-4767
Fax: (202) 482-0687
Web site: www.ita.doc.gov/fcs/uscs/

Export Assistance Center Directory

Web site: www.ita.doc.gov/fcs/uscs/domfld.html

Office of Environmental Technologies Industries

Tel: (202) 482-5225
Fax: (202) 482-5665
Web site: www.environment.ita.doc.gov

Office of Trade Development—Energy Division

Tel: (202) 482-4931
Fax: (202) 482-5361
Web site: www.ita.doc.gov/td/energy/

Trade Information Center

U.S. Department of Commerce
R-TIC Stop
1401 Constitution Avenue, NW
Washington, DC 20230
Tel: (800) 872-8723
E-mail: TIC@ita.doc.gov
Web site: infoserv2.ita.doc.gov/tic.nsf

Advocacy Center

U.S. Department of Commerce
International Trade Administration
Room 3814A
14th St. and Constitution Ave., NW
Washington, DC 20230
Tel: (202) 482-3896
Fax: (202) 482-3508
Web site: www.ita.doc.gov/advocacy

U.S. Foreign and Commercial Service

Tel: (202) 482-5777
Fax: (202) 482-5013
Web site: www.ita.doc.gov/fcs/uscs/

U.S. Department of Energy**Office of Public Inquiries**

1000 Independence Ave., SW
Washington, DC 20589
Tel: (202) 586-5575
Fax: (202) 586-0823
Web site: www.doe.gov

Energy Information Administration

National Energy Information Center
1000 Independence Ave., SW
Washington, DC 20585
Tel: (202) 586-8800
E-mail: infoctr@eia.doe.gov
Web site: www.eia.doe.gov/

Office of Energy Efficiency and Renewable Energy

U.S. Department of Energy
EE1 6C-016
1000 Independence Ave., SW
Washington, DC 20589
Tel: (202) 586-9220
Web site: www.eren.doe.gov

U.S. Country Studies Program and U.S. Initiative on Joint Implementation (Secretariat)

Forrestall Building, PO-6 / GP-196
1000 Independence Ave., SW
Washington, DC 20585
Tel: (202) 586-3288
Fax: (202) 586-3485

U.S. Department of State**Bureau of Public Affairs**

2201 C St., NW
Washington, DC 20520
Tel: (202) 647-6575
Fax: (202) 736-7720
E-mail: publicaffairs@panet.us-state.gov
Web site: www.state.gov

U.S. Environmental Protection Agency**Public Information Center**

401 M St., SW
Washington, DC 20460
Tel: (202) 260-2090
Fax: (202) 565-2411
Web site: www.epa.gov

Office of International Activities

Ronald Reagan Building
1300 Pennsylvania Ave., NW
Washington, DC 20004
Tel: (202) 564-6600
Fax: (202) 565-2407
Web site: www.epa.gov/oia/

U.S. Export-Import Bank

811 Vermont Ave., NW
Washington, DC 20571
Tel: (800) 565-EXIM (3946) or (202) 565-EXIM (3946)
Fax: (202) 565-3380
Web site: www.exim.gov

U.S. Overseas Private Investment Corporation

1100 New York Ave., NW
Washington, DC 20527
Tel: (202) 336-8799
Fax: (202) 408-9859
E-mail: info@opic.gov
Web site: www.opic.gov

U.S. Small Business Administration**Office of International Trade**

409 3rd St., SW
Washington, DC 20416
Tel: (202) 205-6720
Fax: (202) 205-7272
Web site: www.sbaonline.sba.gov/oit/

U.S. Trade and Development Agency

1621 North Kent St., Suite 200
Arlington, Virginia 22209-2131
Tel: (703) 875-4357
Fax: (703) 875-4009
E-mail: info@tda.gov
Web site: www.tda.gov/

Multilateral Development Banks**U.S. Department of Commerce, MDB Operations**

14th St. and Constitution Ave., NW
Room 1107
Washington, DC 20230
Tel: (202) 482-3399
Fax: (202) 273-0927
Web site: www.ita.doc.gov/mdbo

African Development Bank

Boîte Postale 1387
Abidjan 01, Cote d'Ivoire
Tel: +225 (21) 44-44
Fax: +225 (22) 49-07

U.S. Commercial Liaison: U.S. Embassy
5 Rue Jesse Owens
B.P. 1712
Abidjan 01, Cote d'Ivoire
Tel: +225 (21) 46-16
Fax: +225 (22) 24-37

Asian Development Bank (ADB)

6 ADB Ave.
Mandaluyong City
0401 Metro Manila, Philippines
Tel: +63 (2) 632-4444
Fax: +63 (2) 636-2444

U.S. Commercial Liaison:

U.S. Commercial Service
U.S. Embassy, Manila
APO AP 96515
Tel: +63 (2) 890-9364
Fax: +63 (2) 890-9713

North American Office:

1730 Pennsylvania Ave., NW
Suite 975
Washington, DC 20006
Tel: (202) 626-0050

European Bank for Reconstruction and Development (EBRD)

One Exchange Square
London EC2A 2EH UK
Tel: +44 (171) 338-6282
Fax: +44 (171) 338-6102

U.S. Commercial Liaison:

Office of the U.S. Executive Director
Tel: +44 (171) 338-6569
Fax: +44 (171) 338-6487

Global Environment Facility (GEF)

1818 H St., NW
Washington, DC 20433
Tel: (202) 473-8324
Fax: (202) 522-0551

U.S. Commercial Liaison:

Office of the U.S. Executive Director
Tel: (202) 458-0120
Fax: (202) 477-2967

International Finance Corporation (IFC)

1801 K St., NW
Washington, DC 20433
Tel: (202) 473-0642
Fax: (202) 334-8705

U.S. Commercial Liaison:

Office of the U.S. Executive Director
Tel: (202) 458-0120
Fax: (202) 477-2967

Inter-American Development Bank (IDB)

1300 New York Ave., NW
Washington, DC 20036
Tel: (202) 623-1365
Fax: (202) 623-1403

E-mail: pic@iadb.org
U.S. Commercial Liaison:
Office of the U.S. Executive Director
U.S. Commercial Service
Tel: (202) 623-3821
Fax: (202) 623-2039

Inter-American Investment Corporation

1300 New York Ave., NW
Washington, DC 20036
Tel: (202) 623-3900
Fax: (202) 623-2360

U.S. Commercial Liaison:
Office of the U.S. Executive Director
U.S. Commercial Service
Tel: (202) 623-3821
Fax: (202) 623-2039

Multilateral Investment Guarantee Agency (MIGA)

1818 H St., NW
Washington, DC 20433
Tel: (202) 473-6163
Fax: (202) 522-2630

U.S. Commercial Liaison:
Office of the U.S. Executive Director
Tel: (202) 458-0120
Fax: (202) 477-2967

North American Development Bank (NADBank)

700 N. St. Mary's, Suite 1950
San Antonio, TX 78205
Tel: (210) 231-8000
Fax: (210) 231-6232

World Bank

1818 H St., NW
Washington, DC 20433
Tel: (202) 458-5454
Fax: (202) 522-1500

U.S. Commercial Liaison:
Office of the U.S. Executive Director
Tel: (202) 458-0120
Fax: (202) 477-2967

Other Organizations

American Consulting Engineers Council

International Affairs Program
1015 15th St., NW, Suite 802
Washington, DC 20005
Tel: (202) 347-7474
Fax: (202) 842-2436
E-mail: kpuvak@acec.org
Web site: www.acec.org

Business Council for Sustainable Energy

1200 18th St., NW, Ninth Floor
Washington, DC 20036
Tel: (202) 785-0507
Fax: (202) 785-0514
E-mail: bcse@bcse.org
Web site: www.bcse.org

Council of State Governments

State Environmental Initiative
2760 Research Park Drive
P.O. Box 11910
Lexington, KY 40578-1910
Tel: (606) 244-8234
Fax: (606) 244-8001
E-mail: kmarshal@csg.org
Web site: www.csg.org

National Association of State Development Agencies

750 First St., NE, Suite 710
Washington, DC 20002
Tel: (202) 898-1302
Fax: (202) 898-1312
E-mail: jpike@nasda.com
Web site: www.nasda.com

National Pollution Prevention Roundtable

2000 P St., NW, Suite 708
Washington, DC 20036
Tel: (202) 466-7272
Fax: (202) 466-7964
E-mail: tyronefoster@compuserve.com
Web site: www.p2.org

World Trade Centers Association

60 East 42nd St.
Suite 1901
New York, NY 10165
Tel: (212) 432-2626
Fax: (212) 488-0064
Web site: www.iserve.wtca.org

Appendix C

Water and Wastewater Industry Trade Associations

American Metropolitan Sewerage Association (AMSA)

1816 Jefferson Pl., NW
Washington DC 20036-2505
Tel: (202) 833-AMSA (2672)
Fax: (202) 833-4657
E-mail: info@amsa-cleanwater.org
Web site: www.amsa-cleanwater.org

American Water Resource Association (AWRA)

4 West Federal St.
P.O. Box 1626
Middleburg, VA 20118-1626
Tel: (540) 687-8390
Fax: (540) 687-8395
E-mail: info@awra.org
Web site: www.awra.org

American Water Works Association (AWWA)

6666 West Quincy Ave.
Denver, CO 80235
Tel: (303) 794-7711
or
1401 New York Ave., NW, Suite 640
Washington, DC 20005
Tel: (202) 628-8303
Web site: www.awwa.org

Association of Metropolitan Water Agencies (AMWA)

1717 K St., NW, Suite 801
Washington, DC 20036
Tel: (202) 331-2826
Fax: (202) 785-1845
Web site: www.amwa-water.org

Association of State Drinking Water Administrators

1025 Connecticut Ave., NW, Suite 903
Washington, D.C. 20036
Tel: (202) 293-7655
Fax: (202) 293-7656
E-mail: asdwa@erols.com
Web site: asdwa.org

International Private Water Association

205 West End Ave., Suite 8-L
New York, NY 10023
Tel: (212) 873-0920
Fax: (212) 873-5531
Web site: www.ipwa.org

International Water Resources Association

4535 Faner Hall
Southern Illinois University
Carbondale, IL 62901-4516
Fax: (618) 453-2671
E-mail: iwra@siu.edu
Web site: iwra.siu.edu

National Association of Water Companies

1725 K St., NW, Suite 1212
Washington, DC 20006
Tel: (202) 833-8383
Fax: (202) 331-7442
Web site: www.nawc.org

National Ground Water Association

601 Dempsey Road
Westerville, OH 43081
Tel: (800) 551-7379
Fax: (614) 898-7791
Web site: www.ngwc.org

National Rural Water Association

2915 South 13th St.
Duncan, OK 73533-9086
Tel: (580) 252-0629
Fax: (580) 252-4896
Web site: www.nrwa.org

National Water Resources Association

3800 North Fairfax Dr., Suite 4
Arlington, VA 22203
Tel: (703) 524-1544
Fax: (703) 524-1548
Web site: www.nwra.org

Water Environment Federation (WEF)

601 Wythe St.

Alexandria, VA 22314-1994

Tel: (703) 684-2452

Fax: (703) 684-2492

Web site: www.wef.org/

Appendix D

International Programs Affecting the Water and Wastewater Industry

U.S. Agency for International Development (USAID)

Ronald Reagan Building

1300 Pennsylvania Ave., NW

Washington, DC 20523-0016

Tel: (202) 712-4810

Fax: (202) 216-3524

Web site: www.usaid.gov

USAID represents the single most important U.S. government source of opportunities for U.S. exporters of environmental technologies, both in terms of direct procurement and strategic marketing related to environmental assistance projects. USAID is an independent federal government agency that provides economic development and humanitarian assistance to advance U.S. economic and political interests overseas. Water projects and projects with water/wastewater components are funded by USAID in Washington, D.C., and through USAID missions in developing countries.

USAID commodity procurement includes equipment and supplies needed to fulfill USAID project needs and disaster relief, as well as materials financed through USAID-funded commodity import programs. Procurement is usually done by USAID missions in the field, under projects with a value of over \$1 million. It is important for U.S. companies to be able to take advantage of procurement opportunities in order to position themselves in specific overseas markets.

USAID advertises procurement opportunities through the following information sources:

- **Commerce Business Daily (CBD):** The CBD includes announcements about all USAID commodity procurement opportunities and technical assistance projects with a value greater than \$100,000. Contact the U.S. Government Printing Office at (202) 783-3238 to subscribe to the print version or the U.S. Department of Commerce at (202) 482-0632 for the electronic version.
- **Procurement Information Bulletin (PIB):** The PIB lists USAID commodity procurement opportunities and awards greater than \$25,000. Written requests to receive the PIB should be faxed to USAID's Office of Procurement at (202) 216-3051 or requested by telephone at (202) 712-5130.
- **Internet and phone inquiries:** USAID posts information on planned procurement as well as currently issued Requests for Proposals (RFPs) on its Web site (www.info.usaid.gov). Procurement information can also be obtained by calling (800) USAID-73.

Contract awards over \$100,000 are very competitive and a company should be economically sound and knowledgeable about procurement rules and regulations before attempting to bid on federal procurement. It is very important to become familiar with Federal Acquisition Regulations and USAID Acquisition Regulations. These publications are available in most public libraries, or can be ordered from the Government Printing Office.

USAID is most likely to procure environmental equipment through big contracts awarded to consortia of environmental engineering and consulting firms. The equipment supplier would then need to become a subcontractor to the project's prime contractor. Prime contractors have to go through a formal bidding process in equipment procurement. Names, types of businesses, and the subcontracting needs of USAID's prime contractors can be obtained from the Contract Awards section of the CBD; USAID lists of prime contractors available through the Information Center at (202) 712-4810; and federal prime contracting reports available from the Federal Procurement Data Center at (202) 401-1529. It may also be helpful to obtain information on past awards, quantities, costs, and awardees.

USAID puts special emphasis on involving U.S. small and medium-sized enterprises in its technology transfer efforts. The Office of Small and Disadvantaged Business Utilization (OSDBU) is the initial point of contact at USAID for U.S. small businesses. OSDBU is a small business advocacy and advisory office with the responsibility for ensuring that these enterprises get access to USAID programs. The office fulfills the following responsibilities:

- Serves as an information clearinghouse for U.S. small businesses,
- Counsels small businesses on how to do business with USAID,
- Reviews all prime contracts to identify subcontracting opportunities for small businesses,
- Maintains a vendor database, which describes the capabilities of U.S. businesses and organizations interested in participating in the agency's programs,
- Sponsors annual outreach conferences on "How To Do Business with USAID," and
- Develops operations, systems, and procedures to optimize participation of U.S. small businesses in USAID activities.

Even if direct procurement is not envisioned under a significant technology-related USAID project, suppliers in the relevant technology area can benefit from learning about it to identify potential markets in the target country. USAID's *Environment: A Resource Guide* provides a good overview of the agency's principal programs and contracts.

USAID's Global Technology Network (GTN)

USAID Global Bureau's Office of Business Development serves as the central point of contact at USAID for U.S. firms interested in doing business in developing countries. Its activities and services are specifically intended to increase U.S. private enterprise participation in USAID international development programs while opening up new market opportunities for U.S. product and services firms, especially small and medium-sized firms. The Office of Business Development operates regional Business Outreach Offices that provide links to market opportunities in USAID-assisted countries worldwide. They also serve as a source of public information regarding the purpose and impact of U.S. foreign assistance.

The Global Technology Network (GTN) is the principal program of the Office of Business Development. GTN is a free service that creates strategic linkages between U.S. companies and entrepreneurs in developing countries with the goal of transferring U.S. technology overseas. GTN's environmental and energy services assist the U.S. business community in gaining access to global environmental and energy markets by providing trade leads and market information.

The three basic types of leads are equipment purchases, agent/distributor, and joint ventures. Business opportunities are identified by a network of participating in-country public and private sector representatives. Leads are

transmitted to GTN/Washington where they are qualified, matched, and electronically disseminated to U.S. firms registered in GTN's databases. Over 10,000 U.S. environmental and energy firms covering over 600 different subsectors within the environmental industry are currently registered in the GTN system. (Companies can register by calling 1 (800) 872-4348.) To give U.S. companies easier access to GTN business opportunities, GTN is now posting its current trade leads online at www.usgtn.org/pages/envleads.html.

Follow-up on trade leads, as well as information on general USAID procurement, is provided through GTN/Washington and outreach offices in California, Florida, Illinois, Oregon, and Washington (contact information is provided in Appendix A). Additional follow-up on leads is provided through U.S. Export Assistance Centers and 26 state trade partner organizations across the U.S. Partner organizations use GTN's Internet-based Trade Lead Tracking System to assist local companies in responding to GTN trade leads.

Business Support Centers (BSCs) serve as the counseling and information services arm of GTN. BSCs are USAID-funded business development operations designed to help private sector companies (especially small and medium-sized businesses) in developing countries access the technology and expertise needed to compete effectively in local and global markets. BSCs serve as a mechanism for organizing and assisting developing country firms, especially small and medium-sized enterprises seeking access to U.S. technology and expertise. BSCs also provide trade leads to U.S. firms seeking to market their products and services abroad.

The **GTN Travel Grants** program is designed to support U.S. firms pursuing GTN trade leads. After an official or businessperson in another country and a U.S. business have identified a mutual interest in pursuing a business relationship, either organization may apply for a GTN grant for a maximum of \$5,000 to cover the travel costs of one individual's travel to meet with the potential partner. The grants are available for both developing countries and U.S. entrepreneurs.

GTN trade mission services, which include sector briefings and networking support to USAID field missions and domestic partners, are provided in cooperation with other federal and multilateral agencies. Trade missions are held at USAID offices in the International Trade Center in Washington, D.C. Similar services are available for in-coming GTN trade delegations sponsored by USAID missions and U.S. embassies abroad, foreign embassies, or other GTN partner organizations.

Under a cooperative agreement with USAID, the **International Executive Service Corps (IECS)** delivers a

range of business development services to assist small and medium-sized businesses in developing countries through joint ventures with counterpart U.S. companies. The following are GTN's regional programs:

- **GTN-Environmental Technology Network for Asia** (ETNA) was developed by USAID's Global Bureau and the United States-Asia Environmental Partnership (US-AEP). ETNA Asia facilitates the transfer of U.S. environmental technology to Hong Kong, India, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Sri Lanka, Taiwan, and Thailand.
- **GTN-Americas** is a joint program between USAID's Global Bureau and the U.S. Department of Commerce. GTN Americas generates trade leads in Argentina, Bolivia, Brazil, Chile, Costa Rica, Mexico, Peru, Uruguay, and Venezuela.
- **GTN-Ecolinks** offer resources to providers of U.S. technologies. For more information, see the Eurasian-American Partnership for Environmentally Sustainable Economies description on page 83.

GTN also operates in 15 African countries, as well as in Egypt and Jordan.

United States-Asia Environmental Partnership

1720 I St. NW, Suite 700

Washington, DC 20006

Tel: (202) 835-0333

Fax: (202) 835-0366

E-mail: usasia@usaep.org

Web site: www.usaep.org

The United States-Asia Environmental Partnership is an interagency program with funding of more than \$17.5 million from USAID, the Department of Commerce, and the Environmental Protection Agency to promote and reinforce a sustainable cleaner production regime for the industrial and urban sectors in 11 Asian countries: Hong Kong, India, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Sri Lanka, Taiwan, Thailand, and Vietnam. Since its inception in 1993, US-AEP has facilitated over \$1 billion in sales of environmental equipment and services by U.S. companies in Asia.

In cooperation with the Department of Commerce, US-AEP has placed environmental technology representatives in 11 Asian countries to identify trade opportunities for U.S. companies and coordinate meetings between potential Asian and U.S. business partners. These environmental trade specialists meet regularly with decision-makers in industry and government to prepare concise

trade leads that identify Asian buyers, environmental concerns, and proposed technology solutions. Hundreds of such leads per year are forwarded to ETNA where they are matched against a database of over 2,400 registered U.S. companies, and then faxed to those companies that provide the requested technology or service.

Urban environmental infrastructure representatives, located in four Asian countries (India, Indonesia, the Philippines, and Thailand), provide similar services, but focus on problems found in urban areas, such as the provision of clean water, treatment of wastewater, and disposal of solid and hazardous wastes.

In addition to the trade leads provided by the US-AEP technology representatives in Asia, ETNA provides market trend analyses for each US-AEP country; disseminates fact sheets on innovative U.S. technologies to U.S. government counterparts overseas (e.g., US-AEP technology representatives and foreign commercial service representatives); and provides business counseling to U.S. environmental companies interested in expanding their business in Asia. Contact ETNA ((800) 818-9911) to find out more about these and other services.

Export-Link is an Internet resource accessible through the US-AEP Web site (www.usaep.org) that assists companies with their international trade activities and provides practical assistance to all levels of exporters. Export-Link helps U.S. firms evaluate overseas market opportunities and offers advanced business analysis, as well as relevant legal, financial, and market information.

The **Environmental Exchange Program** promotes information sharing on a variety of environmental topics to respond to Asian countries' environmental needs. There are several types of exchanges provided. Environmental business exchanges offer American and Asian businessmen an opportunity to travel to each other's countries to meet potential business partners. Business exchanges may involve a single individual or a study tour of 10 to 20 people. Technical exchanges help representatives from U.S. firms showcase their technology and equipment to Asian decision-makers. Finally, environmental fellowships enable Asian and American professionals to work with peers in their counterpart's home country for a period of one to four months for training, research, or information sharing. Interested U.S. businesses should contact the Institute of International Education (at www.iie.org), which administers the program.

Drawing on the U.S. states' experience in environmental management, the **State Environmental Initiative**, provides matching grants for up to \$150,000 to encourage state-initiated and -managed programs. The initiative was designed to encourage international partnerships in environmental and economic development between

U.S. states and Asian/Pacific nations and territories. The grants serve to facilitate the long-term transfer of U.S. environmental experience, technology, and practice to targeted Asian countries by matching appropriate U.S. technologies and state regulatory and environmental experience with the needs of Asian governments and industries. The grants are issued by the Council of State Governments.

The **Environmental Technology Fund** is administered by the National Association of State Development Agencies (NASDA) and is described under “NASDA Grants” in this section.

Eurasian-American Partnership for Environmentally Sustainable Economies (EcoLinks)

U.S. Regional Office
1400 K St., NW, Suite 650
Washington, DC 20005
Tel: (202) 326-7798
Fax: (202) 326-7709
E-mail: plai@jie.org
Web site: www.ecolinks.org

The Eurasian-American Partnership for Environmentally Sustainable Economics (EcoLinks) offers resources to providers of U.S. technologies as part of its regional initiative to find practical, market-based solutions to industrial and urban environmental problems in Central and Eastern Europe (CEE) and the New Independent States (NIS). It promotes partnerships linking CEE/NIS businesses, local governments, and associations with U.S. counterparts. EcoLinks actively seeks environmental business and technology transfer opportunities in the Czech Republic, Poland, Hungary, Romania, Kazakhstan, Russia, Ukraine, and Macedonia.

The EcoLinks technology transfer program operates in the same way as ETNA does in Asia. Through an interagency agreement between USAID and the Department of Commerce, environmental technology representatives have been placed in selected CEE/NIS countries, namely, the Czech Republic, Hungary, Kazakhstan, Poland, and Romania. These representatives work with GTN to generate trade leads.

A second component of EcoLinks is its grants initiative. Competitively awarded, cost-sharing partnership grants are currently available in amounts of up to \$50,000 to support one-year cooperative projects. Twinning grants (grants that support two-year cooperative projects that lead to lasting partnerships) of up to \$250,000 became available for two-year projects starting in the year 2000.

In addition to the grants, EcoLinks also offers Quick Response Awards to prospective applicants. Awards of up to \$5,000 are designed to meet the immediate and small-scale needs of organizations exploring potential partnerships within the framework of EcoLinks. Activities must either facilitate the matchmaking of potential partners or promote environmental trade and investment. Examples of funded activities include travel to meet potential partners, site visits to facilities, technology demonstrations, and conferences where participants meet partners and forge relationships.

National Association of State Development Agencies (NASDA)

750 First St., NE, Suite 710
Washington, DC 20002
Tel: (202) 898-1302
Fax: (202) 898-1312
Web site: www.nasda.com

The National Association of State Development Agencies (NASDA) administers three similar grant programs promoting U.S. environmental technology exports to Asia and Latin America.

The **Environmental Technology Fund** (Tech Fund), created under the US-AEP, provides matching grants of up to \$20,000 to help small and medium-sized U.S. companies enter Asian environmental markets.¹ Grants match from 20 to 50 percent of total project costs.

The Tech Fund focuses on pollution control, cleaner technologies, and energy efficiency. Preferred projects are those that aim to reduce or eliminate Asia's greenhouse gas emissions. Environmental activities that are eligible for a grant include engineering/technology workshops or seminars, business development missions, and technology/equipment demonstrations. Over the five years of the program's operation, grant funding has been provided for more than 275 projects, facilitating over \$350 million in export sales of U.S. environmental products and technologies.

NASDA has recently completed a similar **Latin American Fund for the Environment** program that has awarded matching grants (of up to \$15,000) for 51 projects in 17 countries throughout Latin America and the Caribbean, and generated over \$21 million in revenues for participating U.S. firms.

Under a cooperative agreement with the Environmental Protection Agency, NASDA is currently considering

1. The countries included under the Environmental Technology Fund do not include China.

a **Program for Environmental Technology Transfer** (PETT) with China. The program would enable small and medium-sized businesses to fund technology demonstrations, workshops, and development programs targeting pollution prevention, air pollution, wastewater treatment, and energy efficiency in China.

U.S. Department of Commerce (DOC)

14th St. and Constitution Ave., NW

Washington, DC 20230

Tel: (202) 482-2000

Web site: www.doc.gov

Within the U.S. Department of Commerce (DOC), several offices and centers provide services that assist U.S. exporters in their business development efforts.

Environmental Technologies Exports (ETE) is the principal resource and key contact point within the DOC for American environmental technology companies, including all business activities associated with environmental protection, assessment, compliance with environmental regulations, pollution control, waste management, remediation of contaminated property, design and operation of environmental infrastructure and the provision and delivery of environmental services. ETE's goal is to enhance the international competitiveness and increase the exports of the U.S. environmental industry by providing basic market and project-related research; supporting a variety of trade promotion activities, including leading trade missions; providing business counseling and representing the interests of U.S. environmental firms; and supporting the creation of public-private partnerships. ETE supports the Environmental Technologies Trade Advisory Committee and the interagency Environmental Trade Working Group, a subcommittee of the Trade Promotion Coordinating Committee.

The U.S. and Foreign Commercial Service (the Commercial Service) has offices located in over 220 cities around the world to assist U.S. exporters. The organization offers U.S. businesses advocacy support and services such as export counseling, trade finance information, customized market research, and identification of trade leads. It also organizes trade missions and events, and offers a Gold Key Service to link U.S. firms with agents and distributors around the world by allowing visiting U.S. company representatives to get a firsthand understanding of the local market and make key contacts that are critical to successful exporting.

The Matchmaker Trade Delegations Program helps small and medium-sized U.S. companies establish business relationships in major markets abroad. Each Match-

maker Trade Delegation targets major markets in two or three countries with strong sales potential for U.S. goods and services. Commercial specialists at U.S. embassies and consulates in the targeted countries prescreen contacts and arrange business appointments for participating U.S. firms. The Matchmaker program also offers market research and evaluation of the market potential for a specific product or service; in-depth country market and trade finance briefings; interpreter services and logistical support; and export counseling before, during, and after the trip.

The Advocacy Center promotes U.S. firms through advocacy by high-level U.S. Government officials and tracks environmental projects worldwide. **The Trade Information Center (TIC)** is a comprehensive resource for information on all federal government export assistance programs. TIC staff counsel small and medium-sized U.S. companies that are entering the export market. **Multilateral Development Bank Operations** provides the U.S. exporting community with comprehensive information on all multilateral development bank programs and opportunities.

Export Assistance Centers are a joint effort of the Commercial Service, the Small Business Administration, the Export-Import Bank of the United States, and USAID. Center personnel counsel small and medium-sized export-ready businesses and help them develop customized international business strategies. The centers are located throughout the United States and in nearly 70 countries abroad.

U.S. Trade Development Agency Programs

1621 North Kent St., Suite 200

Arlington, VA 22209-2131

Tel: (703) 875-4357; fax: (703) 875-4009

E-mail: info@tda.gov

Web site: www.tda.gov

The U.S. Trade and Development Agency (TDA) is an independent federal agency dedicated to assisting U.S. companies in pursuing business opportunities in developing countries and responding to foreign competition. It sponsors feasibility studies, definitional missions, and desk studies for major public and private sector projects in order to promote the use of U.S. goods and services in project implementation. By funding feasibility studies that evaluate the technical, legal, economic, and financial aspects of development projects, TDA provides U.S. companies with an opportunity to get in on the ground floor of a project.

TDA focuses primarily on feasibility studies for infrastructure development projects. Funding from the agency usually ranges from \$150,000 to \$750,000 for public sector projects. These feasibility studies also advise project sponsors about the availability of specific U.S. equipment and services. TDA publishes the *TDA Pipeline*, its biweekly newsletter, that highlights new definitional missions, feasibility study opportunities (also advertised in the *Commerce Business Daily*), and upcoming orientation visits and conferences. TDA business briefings and events often provide a good introduction to current opportunities in a specific sector or region.

TDA hosts approximately 45 orientation visits each year. These week-long reverse trade missions bring foreign buyers to the United States to see equipment they may need for development projects. U.S. suppliers that participate in these visits are able to showcase their products and expertise, while making valuable international contacts. In conjunction with these visits, TDA often hosts a business briefing to allow U.S. companies to meet with the visiting delegation to hear more details about their needs.

Additionally, TDA hosts a number of events to assist in opening global markets to U.S. businesses. Each event offers:

- Workshops that highlight the best project opportunities for U.S. businesses in the region or sector;
- A complete briefing book profiling each project in detail;
- One-on-one meetings between U.S. companies and foreign project officials; and
- Strategy and insight into some of the world's most challenging and rewarding emerging markets.

U.S. Environmental Protection Agency (EPA)

Office of International Activities
Ronald Reagan Building
1300 Pennsylvania Ave., NW
Washington, DC 20004
Tel: (202) 564-6600
Fax: (202) 565-2407
Web site: www.epa.gov/oia

The Environmental Protection Agency's (EPA) international programs play an important role in helping the U.S. environmental sector expand its export base. U.S. private sector groups have repeatedly underscored the importance of EPA's international technology and technical assistance programs in creating markets for U.S. environmental goods and services.

By showcasing the effectiveness and capabilities of available and emerging U.S. environmental technologies, EPA technology diffusion programs in developing countries lead to follow-on commercial opportunities for U.S. firms. EPA's training programs also prepare the way for the exports of U.S. technologies. The training programs usually identify U.S. environmental technology manufacturers in the relevant sectors.

Under a cooperative agreement with the EPA, the National Association of State Development Agencies (NASDA) is currently conducting a **Program for Environmental Technology Transfer (PETT)** to China. The program enables small and medium-sized businesses to fund technology demonstrations, workshops, and development programs targeting pollution prevention, air pollution, wastewater treatment, and energy efficiency in China.

EPA is widely recognized as the world's leading source of environmental information which helps build capacity for the use of advanced technologies. In addition to providing thousands of pages of technical data via the Internet, EPA also makes information on U.S. environmental technology vendors available to potential buyers. For example, the **Vendor Information System for Innovative Treatment Technologies (VISITT)** provides vendor-supplied information on innovative technologies that can be used to treat contaminated groundwater, sludges, and sediments. EPA's **Clean Air Technology Center** provides a similar resource for information on emerging and existing air pollution prevention and control technologies. Through its International Visitors Program, EPA staff helps arrange tours of U.S. facilities with innovative technologies in use, and set up meetings with U.S. technology suppliers.

Appendix E

U.S. Environmental Trade Working Group Contacts

Department of Commerce

Environmental Technologies Exports Office
14th St. and Constitution Ave., NW
Room 1003
Washington, DC 20230
Tel: (202) 482-5227
Fax: (202) 482-5665

Department of Defense

3300 Defense Pentagon
Room B, 739
Washington, DC 20301
Tel: (703) 614-8784
Fax: (703) 695-1495

Department of Energy

Office of International Energy,
Policy, Trade and Investment
1000 Independence Ave., SW
Room 73034
Washington, DC 20589
Tel: (202) 586-5493
Fax: (202) 586-3047

Department of the Interior

1849 C St., NW
Room 6123
Washington, DC 20240
Tel: (202) 208-6182
Fax: (202) 208-4561

Department of State

Office of Environment and Development
2201 C St., NW
Room 7831
Washington, DC 20520-7818
Tel: (202) 647-2232
Fax: (202) 647-0217

Department of Treasury

Office of Trade and Investment Policy
1500 Pennsylvania Ave., NW
Room 3208
Washington, DC 20220
Tel: (202) 622-0168
Fax: (202) 622-5304

Environmental Protection Agency

Office of International Activities
401 M St., SW, Room W1135
Washington, DC 20460-2610
Tel: (202) 260-4870
Fax: (202) 260-4470

Export-Import Bank

811 Vermont Ave., NW
Room 1257
Washington, DC 20571
Tel: (202) 565-3540
Fax: (202) 565-3548

Overseas Private Investment Corporation

1100 New York Ave., NW
Washington, DC 20527
Tel: (202) 336-8628
Fax: (202) 218-0104

Small Business Administration

Office of International Trade
409 3rd St., SW
Mail Code 7550
Washington, DC 20416
Tel: (202) 205-6720
Fax: (202) 205-7272

Trade and Development Agency

Office of Exports
2201 C St., NW, Room 309, SA-16
Washington, DC 20523-1810
Tel: (703) 875-4357
Fax: (703) 875-4009

U.S. Agency for International Development

Office of Energy, Environment, and Technology
Room 508, SA-18
Washington, DC 20523-1810
Tel: (703) 875-4465
Fax: (703) 875-4053

U.S.-Asia Environmental Partnership

320 12th St., NW, Suite 3208
Washington, DC 20523
Tel: (202) 647-7037
Fax: (202) 647-5861

U.S. Environmental Training Institute

1000 Thomas Jefferson St., NW
Suite 106
Washington, DC 20007
Tel: (202) 338-3400
Fax: (202) 338-4782

U.S. Information Agency

Office of Environment Security
USIA, Room 848
301 4th St., SW
Washington, DC 20547
Tel: (202) 619-6655
Fax: (202) 619-5646

U.S. Trade Representative

Office of Environment and Natural Resources
600 17th St., NW, Room 410
Washington, DC 20508
Tel: (202) 395-7320
Fax: (202) 395-4579

White House

Office of Science and Technology Policy
Old Executive Office Building
Room 443
Washington, DC 20502
Tel: (202) 456-6084
Fax: (202) 456-6025

U.S.-ASEAN Council

1400 L St., NW, Suite 375
Washington, DC 20005-3509
Tel: (202) 289-1911
Fax: (202) 289-0519

United States National Committee for Pacific Economic Cooperation

1755 Massachusetts Ave., NW
Suite 412
Washington, DC 20036-2102
Tel: (202) 745-7444
Fax: (202) 797-1355

Pacific Basin Economic Council

1100 Connecticut Ave., NW
Suite 1300
Washington, DC 20036
Tel: (202) 728-0993
Fax: (202) 728-0998

Appendix F

Helpful Documents

U.S. Government Reports

Environmental Market in Japan, U.S. Department of Commerce, International Trade Administration, 1998.

Financing Environmental Exports: A Guide to the Fundamentals and Sources, U.S. Department of Commerce, International Trade Administration, 1998.

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Appendix G

Water Equipment Harmonized Tariff Schedule (HTS) Numbers

3926909885	other articles of plastic and other materials, headings 3901–3914, NESOI
4601200000	mats, matting, and screens of vegetable materials
5603140000	non-wovens, of manmade filament, weighing greater than 150g/m ²
8413600020	hydraulic fluid power pumps, rotary positive, vane
8413600030	hydraulic fluid power pumps, rotary positive displacement
8413600040	hydraulic fluid power pumps, rotary positive displacement
8413600070	roller pumps, rotary positive displacement
8413600090	rotary positive displacement pumps, NESOI
8413702004	submersible pumps, centrifugal
8413702005	centrifugal pump, single-stage, single-suction, close-coupled, discharge outlet under 5.08 cm in diameter
8413702015	centrifugal pump, single-stage, single-suction, close-coupled, discharge outlet over 5.08 cm in diameter
8413702022	centrifugal pump, single-stage, single-suction, frame-mounted, discharge outlet under 7.6 cm in diameter
8413702025	centrifugal pump, single-stage, single-suction, frame-mounted, discharge outlet over 7.6 cm in diameter
8413702030	centrifugal pumps, single-stage, double-suction
8413702040	centrifugal pumps, multi-stage, single- or double-suction
8413702090	centrifugal pumps for liquids, NESOI
8413810020	turbine pumps, NESOI
8413810030	household water systems, self-contained; windmill pumps
8413810040	pumps for liquids, NESOI
8421210000	water filtering or purifying machinery and apparatus
8421290005	refrigerant recovery and recycling units
8421290015	oil-separation equipment
8421290040	hydraulic fluid power filters, rated ge 1000 kpa
8421290065	other filtering, purifying equipment for liquids NESOI
8479820040	mixing, kneading, or stirring machines, NESOI
8479909565	parts of machines/mechanical appliances for treat mtl, NESOI
8479909580	other parts of machines and mechanical appliances

NESOI = not elsewhere specified or included

Source: U.S. International Trade Commission, *Harmonized Tariff Schedule of the United States Annotated for Statistical Reporting Purposes*, 14th ed. (Washington, D.C.: U.S. Government Printing Office, 2001).

Appendix H

U.S. Exports of Water Equipment by Country, 1996–2000 (U.S. dollars)

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Mexico	93,343,528	127,157,630	1,289,996,024	1,872,116,328	2,390,043,094
Canada	409,997,307	482,477,551	989,460,379	1,295,019,848	1,344,168,465
Japan	176,353,541	144,427,435	174,236,876	374,991,002	449,632,374
South Korea	102,886,025	83,996,914	38,458,813	248,243,991	390,933,496
Taiwan	60,743,153	77,967,756	108,215,349	244,196,294	362,394,294
Singapore	36,646,507	45,230,488	61,353,899	183,567,220	262,563,797
Germany	67,208,335	61,333,742	88,682,297	170,097,231	230,560,520
United Kingdom	75,019,301	79,073,038	143,278,219	196,174,867	208,886,139
France	53,110,661	86,978,086	115,563,487	163,321,098	178,407,443
China	41,354,395	45,127,524	63,643,971	99,783,457	126,844,896
Netherlands	20,896,491	30,900,506	43,724,770	133,969,341	105,169,938
Malaysia	26,023,435	29,156,205	18,141,955	66,113,790	96,348,261
Italy	13,532,509	16,173,438	25,581,771	64,493,152	84,913,383
Belgium	24,447,034	39,228,640	57,688,342	69,368,090	84,329,724
Israel	10,459,408	10,161,733	13,974,421	64,192,547	77,280,271
Australia	34,644,327	40,091,322	51,484,883	68,254,903	63,593,976
Philippines	20,207,644	25,620,903	16,667,567	65,699,970	63,205,375
Hong Kong	29,198,793	32,368,092	43,258,295	57,848,505	61,016,339
Saudi Arabia	39,202,950	57,230,214	42,749,539	41,917,655	48,371,345
Ireland	3,947,662	7,114,857	13,589,077	45,061,967	44,942,225
Brazil	20,840,445	33,318,195	39,477,569	45,793,730	44,434,150
Venezuela	14,229,571	15,042,739	23,153,567	39,124,016	39,287,994
Russia	12,528,744	18,531,684	21,672,546	30,407,587	35,641,692
Thailand	36,052,558	38,921,066	25,734,794	27,729,191	33,764,047
Spain	13,345,247	14,878,713	19,030,488	38,774,007	33,153,723
Egypt	19,326,968	19,330,024	18,028,679	27,061,179	26,099,155
India	16,725,260	12,256,370	21,372,203	19,488,029	24,094,831
Argentina	16,066,988	13,926,747	21,339,355	27,439,289	19,422,350
Switzerland	7,402,770	6,011,720	7,633,475	22,023,096	18,887,465
Chile	14,992,963	22,293,715	18,570,350	17,453,843	18,679,696
United Arab Emirates	10,404,792	9,779,734	10,042,325	18,884,156	17,783,142
Kuwait	12,982,402	5,583,950	13,624,825	5,918,198	15,216,345
Sweden	6,836,346	8,143,899	9,427,262	13,572,077	15,008,546
Czech Republic	1,606,234	886,805	2,068,443	3,107,089	14,991,975
Dominican Republic	4,127,007	3,243,029	7,541,428	7,918,970	12,045,521
Republic of South Africa	7,218,152	11,034,848	11,802,615	10,998,955	11,852,622
Austria	3,172,623	3,797,140	8,331,394	12,905,912	11,617,969
Peru	4,438,113	9,620,736	12,864,125	8,316,944	11,170,875
Hungary	425,422	340,085	604,539	2,272,754	10,528,350
Indonesia	20,167,804	11,940,330	8,923,994	13,230,407	10,481,445
Aruba	276,884	399,702	7,040,696	58,830,092	9,799,351
Colombia	14,691,827	11,595,861	15,273,857	17,647,388	9,793,857

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Denmark	9,847,560	6,872,075	8,428,985	10,127,250	9,749,023
New Zealand	5,060,169	6,149,190	7,782,156	12,773,825	9,042,307
Honduras	1,541,329	1,863,322	4,611,699	7,746,125	8,582,086
Brunei	3,010,596	1,034,780	748,780	1,761,796	8,528,789
Costa Rica	3,400,613	2,030,650	3,589,460	8,660,123	7,957,232
Finland	5,366,144	3,387,242	4,916,642	9,696,857	7,873,401
Turkey	5,986,321	16,792,489	17,481,784	14,627,019	7,404,486
Algeria	3,084,290	2,400,537	1,790,405	3,004,073	6,737,342
Bahamas	2,225,061	5,602,573	3,438,720	2,856,137	5,539,359
Norway	2,201,109	3,728,101	4,202,744	5,840,591	4,433,538
Jamaica	2,628,790	2,548,887	4,165,514	2,992,951	4,423,618
Trinidad and Tobago	1,584,751	5,817,088	3,925,879	3,660,501	4,189,865
Poland	4,029,119	4,538,150	4,722,754	5,767,893	3,994,755
Guatemala	1,819,865	2,383,709	5,962,612	5,271,870	3,945,651
Ecuador	4,570,760	6,575,657	5,825,572	5,958,286	3,941,795
Nigeria	1,855,543	1,046,557	6,083,844	2,464,253	3,831,012
El Salvador	2,049,595	3,018,717	2,505,590	3,896,969	3,672,651
Panama	1,231,935	1,482,369	6,693,049	9,065,526	3,644,975
Kazakhstan	115,031	215,179	732,380	880,394	3,482,866
Jordan	2,696,061	2,579,963	4,706,286	2,433,578	3,365,946
Greece	1,698,359	7,201,040	2,545,769	5,223,201	3,296,321
Cyprus	263,009	459,306	531,312	1,131,102	2,893,168
Paraguay	241,461	710,914	691,831	227,829	2,630,221
Qatar	1,034,475	7,435,876	771,305	1,326,001	2,593,578
Portugal	2,177,537	1,807,911	1,720,345	3,433,549	2,559,337
Malta and Gozo	587,186	1,102,659	1,551,673	1,181,489	2,453,119
Angola	433,268	287,511	2,705,289	3,007,116	1,900,579
Oman	8,154,660	4,244,563	2,223,178	2,166,612	1,873,302
Kenya	176,379	370,269	372,216	446,882	1,831,741
Haiti	395,283	233,886	448,134	360,274	1,792,342
Azerbaijan	1,028,035	334,278	28,225	41,722	1,746,466
Vietnam	2,125,510	1,036,905	1,658,334	2,332,430	1,658,506
Bermuda	562,691	378,559	886,069	2,624,259	1,656,159
Tunisia	792,580	871,525	2,085,583	579,709	1,637,262
Bahrain	575,170	511,059	1,219,054	1,859,758	1,618,225
Nicaragua	838,346	642,655	599,960	1,018,075	1,469,967
Iceland	216,253	673,976	632,687	695,512	1,353,039
Pakistan	1,058,705	5,146,099	4,223,487	2,330,943	1,334,016
Barbados	185,558	341,351	446,966	2,259,034	1,327,151
Belize	1,095,432	512,803	887,410	1,840,257	1,323,897
Senegal	116,897	134,012	41,763	98,600	1,219,891
Grenada	118,539	104,059	3,124,868	472,319	1,203,998
Morocco	171,820	337,138	4,065,154	2,853,543	1,165,538
Slovenia	289,229	19,342	353,276	130,197	1,145,730
Uzbekistan	527,137	450,854	234,289	1,464,970	1,120,221
Croatia	44,654	1,943,477	247,565	196,462	1,108,842
Syria	1,664,977	1,359,089	1,776,321	1,274,448	1,056,534
Netherlands Antilles	593,732	2,758,352	717,390	2,699,495	1,027,035

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Bolivia	613,201	1,273,386	1,119,340	2,387,346	992,173
Romania	645,431	650,267	381,705	1,512,744	867,201
Suriname	785,763	534,714	601,938	634,954	714,186
Uruguay	692,387	865,943	544,900	1,465,742	684,388
Sri Lanka (Ceylon)	371,504	177,335	693,253	1,044,625	547,424
Congo	136,952	830,719	1,530,088	429,782	537,877
Federated States of Micronesia	0	2,660	265,857	74,295	535,262
Luxembourg	285,532	62,404	410,173	1,139,943	533,616
Ghana	615,420	423,613	246,446	654,284	519,772
Lebanon	2,007,816	2,761,344	1,598,702	1,407,620	503,449
Macedonia	0	0	97,278	398,871	493,418
Latvia	140,335	557,759	390,094	390,318	464,678
Yemen (Sana)	107,186	119,499	306,065	557,149	458,385
Slovakia	56,123	159,718	1,099,429	474,028	411,617
Nauru	0	0	21,587	23,160	404,461
Ukraine	294,952	3,832,211	3,019,641	504,612	383,258
Cayman Islands	223,476	534,906	685,546	1,841,604	362,291
Antigua Barbuda	459,127	87,773	528,581	296,677	279,687
St. Lucia	123,604	93,956	537,282	564,039	271,225
Guyana	206,480	346,004	173,694	1,226,128	269,032
British Virgin Islands	146,803	290,989	198,371	258,789	255,786
Bangladesh	755,373	454,877	580,392	157,543	254,924
Malawi	82,218	0	12,629	4,823	244,822
Lithuania	91,786	1,053,145	172,084	1,588,935	230,394
Gabon	34,881	45,033	274,996	27,771	226,108
Turks and Caicos Islands	184,411	463,223	542,247	395,202	217,243
Guadeloupe	108,369	132,083	320,062	143,918	217,022
Mauritius	644,587	2,590	116,818	145,421	205,148
Burkina Faso (Upper Volta)	0	12,120	0	70,000	196,575
Belarus	474,125	511,712	448,533	708,025	192,284
St. Christopher-Nevis	63,968	156,205	38,907	153,840	169,319
Zaire	320,268	16,203	33,425	14,602	167,974
Anguilla	25,593	65,612	164,139	428,354	163,004
Bosnia-Herzegovina	0	0	25,124	39,166	161,433
Fiji	97,376	10,440	12,997	155,292	153,406
Seychelles	21,846	0	587,105	55,022	149,741
Zimbabwe	120,462	145,603	73,357	157,340	146,461
Georgia	399,271	156,347	0	37,215	136,559
Tanzania	3,440	3,136	28,020	74,977	126,547
Uganda	0	0	84,101	26,644	123,531
French Polynesia	152,690	184,026	202,501	528,683	121,746
Madagascar	0	0	26,866	83,461	120,548
Cameroon	89,506	58,000	79,581	351,011	111,423
Turkmenistan	54,255	288,352	11,919	90,775	107,355
Rwanda	0	0	8,191	0	103,000
Tokelau Islands	0	0	11,618	0	102,262
Ethiopia	145,276	12,845	128,177	8,188	97,724

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Estonia	95,187	16,341	223,900	166,759	95,467
Palau	0	104,794	38,400	38,160	81,185
Maldives Islands	187,395	269,335	347,875	586,019	79,738
Bulgaria	59,619	45,579	131,375	1,003,722	79,023
Mali	4,584	57,746	5,638	10,432	76,276
Togo	0	43,545	17,313	93,736	73,300
Western Samoa	3,000	20,900	2,602	3,477	72,320
Mozambique	111,625	170,768	20,265	100,030	68,510
Ivory Coast	15,111	2,268,151	181,688	56,308	66,899
Macao	11,145	167,942	371,586	98,747	58,784
French Guiana	24,052	36,194	49,368	93,710	53,939
Sierra Leone	8,315	0	0	0	51,223
Equatorial Guinea	840,610	1,365,998	1,029,403	1,443,188	40,197
Burma (Myanmar)	63,983	2,693	23,000	115,713	36,979
Chad	10,618	15,055	82,826	0	36,300
Liechtenstein	6,035	5,725	19,109	0	34,524
Papua New Guinea	52,512	78,809	31,951	120,203	33,609
Niger	0	18,922	0	0	33,372
St. Vincent and Grenadines	6,953	73,028	61,726	83,001	33,073
New Caledonia	153,882	82,815	4,811	359,219	31,743
Martinique	41,532	16,192	88,299	927,985	28,887
Mauritania	32,076	6,047	7,759	2,793	27,761
Guinea	54,866	19,180	36,960	127,435	24,929
Albania	12,354	0	0	65,465	18,819
Gibraltar	45,001	47,735	26,466	19,429	18,554
Réunion	0	46,028	0	17,090	13,278
Marshall Islands	141,621	91,758	330,089	330,516	12,191
St. Pierre and Miquelon	0	0	0	9,973	12,088
Swaziland	0	7,150	0	48,677	11,600
Dominica	29,070	4,980	27,797	69,763	11,232
West Bank	0	0	9,609	0	10,430
Liberia	0	29,740	35,531	360,589	10,280
Djibouti	13,000	56,099	62,889	54,092	9,702
Zambia	10,646	81,672	154,254	65,278	8,529
Eritrea	7,629	0	49,130	65,651	6,720
Yugoslavia (Serbia/Montenegro)	0	436,193	35,157	29,186	6,533
Montserrat	0	96,306	0	2,560	6,228
Namibia	32,502	84,478	16,820	0	5,513
Lesotho	0	0	2,814	0	5,000
Cape Verde	0	28,685	0	274,624	4,903
Kiribati (Gilbert Islands)	3,619	8,890	0	4,100	4,771
Moldova	0	34,037	587,084	217,103	4,500
São Tome and Principe	0	0	0	0	3,964
Mongolia	7,740	7,950	19,612	21,646	2,863
Cambodia (Kampuchea)	2,865	28,600	21,078	0	2,590
Vanuatu (New Hebrides)	0	0	0	0	2,547
Andorra	0	0	17,604	0	0

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Benin	0	0	4,853	0	0
Botswana	0	60,000	0	30,425	0
Central African Republic	0	231,249	0	12,473	0
Cook Islands	2,563	0	4,102	0	0
Faroe Islands	0	0	50,130	71,698	0
French S. Antarctic Territory	0	130,962	0	0	0
Gambia	16,268	0	0	34,429	0
Gaza Strip	0	0	0	540,598	0
Greenland	44,859	3,341	0	11,015	0
Korea, North	0	0	0	8,390	0
Kyrgyzstan	2,551	28,650	381,433	0	0
Laos	0	0	121,149	0	0
Nepal	217,000	31,506	222,372	34,654	0
Niue	339,441	926,519	0	0	0
Solomon Islands	0	0	0	6,495	0
Sudan	154,328	102,150	0	0	0
Svalbard, Jan Mayen Island	0	0	14,260	97,829	0
Tonga	0	3,802	2,782	3,210	0
Total	1,703,201,600	1,939,040,860	3,885,819,399	6,186,760,483	7,295,843,950

Source: U.S. International Trade Commission, *Harmonized Tariff Schedule of the United States Annotated for Statistical Reporting Purposes*, 14th ed. (Washington, D.C.: U.S. Government Printing Office, 2001).

Appendix I

Water Equipment Exports by HS Number, 1996–2000

(domestic exports, FAS value, U.S. dollars)

<i>HS Number</i>	<i>Description</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
3926909885	Oth Art of Plastic and Oth Mat, Hdg 3901-3914, NESOI	0	0	1,946,467,338	2,398,615,497	2,860,166,919
4601200000	Mats, Matting and Screens of Vegetable Materials	2,517,038	2,957,518	3,228,831	3,172,077	4,795,897
5603140000	Nonwovens, of Manmade Filament, Weighing Gt 150g/M2	30,121,265	47,894,757	52,534,167	43,537,218	88,652,769
8413600020	Hydraulic Fluid Power Pumps, Rotary Positive, Vane	117,247,416	104,178,978	129,505,111	197,175,250	191,620,001
8413600030	Hydraulic Fluid Power Pumps, Rotary Positive Displ	36,583,572	44,271,788	43,957,145	37,089,486	39,232,439
8413600040	Hydraulic Fluid Power Pumps, Rotary Positive Displ	44,157,484	58,377,691	79,496,790	66,748,744	64,038,300
8413600070	Roller Pumps, Rotary Positive Displacement	915,700	1,169,156	2,711,892	5,538,850	2,194,256
8413600090	Rotary Positive Displacement Pumps, NESOI	107,055,546	132,425,519	107,547,131	109,747,960	120,703,574
8413702004	Submersible Pumps, Centrifugal	63,318,194	74,142,726	61,866,804	73,067,782	80,231,956
8413702005	Cent Pmp Liq, Sing-Stg, Sing-Suc, Clos-Coup, Dis5.08cm	28,825,891	28,202,965	20,955,834	20,296,618	18,941,926
8413702015	Cent Pmp Liq, Sing-Stg, Sing-Suc, Clos-Coup, Ov 5.08cm	10,703,595	8,369,752	5,455,856	7,499,621	6,996,571
8413702022	Cent Pmp Liq, Sing-Stg, Sing-Suc, Clos-Coup, Disc7.6cm	26,199,344	28,592,995	22,819,717	19,124,232	20,058,405
8413702025	Cent Pmp Liq, Sing-Stg, Sing-Suc, Clos-Coup, Ov C7.6cm	27,672,914	32,158,716	24,733,877	21,258,470	25,744,541
8413702030	Centrifugal Pumps for Liquids, Sing-Stage, Dbl-Suc	5,281,174	10,778,979	8,099,479	5,571,524	7,215,520
8413702040	Cent Pumps for Liquids Multi-Stag, Sing or Doub-Suc	39,376,422	52,761,930	57,380,236	50,144,464	49,601,298
8413702090	Centrifugal Pumps for Liquids, NESOI	110,852,434	134,713,883	154,488,235	149,244,613	159,221,126
8413810020	Turbine Pumps, NESOI	20,932,622	23,686,464	30,652,747	31,136,119	29,837,688
8413810030	Household Water Syst, Self-Contain; Windmill Pumps	11,123,433	11,845,861	6,854,429	8,614,371	7,881,434
8413810040	Pumps for Liquids, NESOI	178,141,773	193,160,963	190,626,591	192,606,318	200,601,340
8421210000	Water Filtering or Purifying Machinery & Apparatus	634,790,553	664,389,246	628,338,373	579,591,512	638,157,780
8421290005	Refrigerant Recovery and Recycling Units	2,287,885	2,274,773	5,131,453	8,860,041	13,586,039
8421290015	Oil-Separation Equipment	22,328,945	28,726,226	28,897,677	22,516,084	28,560,531
8421290040	Hydraulic Fluid Power Filters, Rated Ge 1000 Kpa	6,746,503	8,704,507	9,343,805	14,809,992	16,531,155
8421290065	Other Filtering, Purifying Equip. for Liquids, NESOI	176,021,897	188,187,767	206,742,199	235,153,517	218,225,109
8479820040	Mixing, Kneading or Stirring Machines, NESOI	0	57,067,700	57,983,682	56,850,010	46,059,286
8479909565	Parts of Mach/Mechanical Appl for Treat Mtl, NESOI	0	0	0	22,789,832	27,283,920
8479909580	Other Parts of Mach & Mechanical Appliances	0	0	0	1,806,000,281	2,329,704,170
Total		1,703,201,600	1,939,040,860	3,885,819,399	6,186,760,483	7,295,843,950

NESOI = not elsewhere specified or included

Source: U.S. International Trade Commission, *Harmonized Tariff Schedule of the United States Annotated for Statistical Reporting Purposes*, 14th ed. (Washington, D.C.: U.S. Government Printing Office, 2001).

Appendix J

U.S. Imports of Water Equipment by Country, 1996–2000 (imports for consumption, Customs value, U.S. dollars)

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Canada	523,764,993	611,943,451	714,236,373	857,201,935	941,134,164
Japan	652,019,047	642,685,660	616,871,948	627,582,023	741,586,794
China	569,998,125	480,060,828	428,283,935	524,155,775	635,652,323
Germany	458,014,550	503,896,405	542,250,365	562,207,696	574,370,738
Mexico	220,495,897	273,602,037	397,456,859	411,005,780	415,702,127
United Kingdom	207,900,915	250,737,527	288,998,862	346,357,762	292,326,227
Italy	166,924,999	211,604,096	194,804,522	246,276,890	217,078,083
Taiwan	162,373,691	164,048,077	171,065,192	182,285,181	211,704,115
Sweden	101,989,697	104,360,940	105,012,838	112,735,178	149,751,436
France	101,756,658	103,401,229	106,741,578	116,719,994	117,265,332
Switzerland	81,789,770	81,038,280	100,447,009	116,862,502	109,956,485
Netherlands	61,118,843	55,404,048	49,250,878	66,330,210	77,452,763
South Korea	68,337,106	67,271,693	58,193,781	59,100,084	67,101,440
Israel	45,981,046	46,432,483	55,937,179	47,054,243	63,952,632
Ireland	17,033,982	22,962,434	21,761,268	43,597,804	45,501,025
Hong Kong	48,590,157	45,716,001	31,421,936	30,372,128	38,043,249
Belgium	31,043,384	25,474,502	27,849,730	30,031,682	37,894,170
Denmark	36,122,132	41,971,332	26,520,357	34,637,065	36,494,768
Austria	19,151,442	26,433,750	28,243,441	31,070,368	32,480,858
Finland	19,449,472	20,954,600	32,299,527	26,082,709	28,517,870
Australia	13,872,873	11,360,687	23,662,830	15,820,135	22,418,948
Spain	11,927,766	12,106,823	18,459,380	13,350,398	22,224,890
Dominican Republic	9,648,486	9,082,796	10,436,062	12,528,124	19,023,474
Brazil	15,567,582	14,685,568	17,677,855	13,839,663	18,439,571
Singapore	19,142,990	24,426,235	28,258,815	15,347,222	17,056,955
India	5,555,414	5,060,965	6,491,813	9,158,304	14,501,264
Malaysia	14,221,177	8,679,515	10,962,720	11,065,929	14,229,996
Thailand	16,672,814	21,790,559	12,146,384	10,607,940	12,973,605
Costa Rica	8,215,662	9,365,890	7,734,794	8,578,133	8,697,079
Norway	6,341,165	7,861,444	7,006,100	5,818,503	7,458,694
Republic of South Africa	6,473,088	8,434,128	6,774,349	7,129,991	7,265,435
Poland	2,960,479	5,082,631	3,727,971	4,834,751	6,898,556
Turkey	4,148,600	3,012,612	4,942,419	4,360,378	6,565,716
Philippines	5,622,667	9,174,422	4,606,780	4,555,622	6,054,629
Hungary	1,224,226	2,146,367	3,133,816	3,838,338	5,906,183
New Zealand	1,747,727	2,438,139	2,561,635	3,235,899	5,518,492
Indonesia	6,976,310	3,368,501	4,339,911	4,057,221	4,628,107
Czech Republic	1,700,554	1,188,138	1,801,259	2,230,996	4,081,709
Sri Lanka (Ceylon)	74,927	317,076	394,970	660,008	2,384,703
Colombia	441,988	649,613	563,421	969,754	2,129,617

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Honduras	66,912	407,522	788,689	632,175	1,318,806
Venezuela	1,386,114	1,613,814	1,064,820	818,719	1,053,567
Argentina	750,714	467,188	339,771	539,293	1,046,212
Luxembourg	310,662	543,754	680,452	200,233	994,626
Slovenia	1,014,580	652,090	539,715	665,892	942,490
Portugal	804,275	577,528	675,519	1,065,488	849,386
Panama	101,835	58,013	339,223	289,128	600,863
Chile	327,742	169,496	302,656	268,835	594,355
Greece	598,789	2,029,228	735,956	678,801	549,136
Trinidad and Tobago	85,928	267,146	699,122	857,518	486,351
Macao	184,769	859,194	182,490	80,162	485,363
Saudi Arabia	47,472	15,352	7,194	114,294	437,125
Egypt	99,045	10,662	30,569	260,925	434,246
Bangladesh	80,690	45,619	10,138	42,036	429,859
Slovakia	251,603	170,238	279,134	596,679	365,683
West Bank	0	0	0	0	289,581
Lithuania	83,212	149,518	135,028	182,597	282,900
United Arab Emirates	342,768	645,380	81,789	130,569	246,567
Russia	818,822	555,721	266,678	166,847	238,959
Liechtenstein	522,252	684,763	588,081	609,047	220,324
Oman	9,000	0	8,811	65,667	214,999
Jamaica	80,881	154,507	146,655	56,839	187,325
Bulgaria	21,335	46,312	56,719	78,823	185,103
El Salvador	5,247	12,766	1,873	10,937	163,801
Peru	92,477	107,507	497,951	127,635	159,552
Guatemala	58,484	28,626	63,939	103,016	125,033
Romania	38,860	66,664	45,462	28,321	123,808
Iceland	69,890	37,503	21,435	55,654	110,242
Malta and Gozo	50,687	77,332	8,987	11,737	100,859
Niger	4,388	1,456	51,087	8,428	99,031
Bahrain	0	0	42,400	22,823	95,709
Cameroon	263,015	0	117,593	28,034	91,618
Pakistan	11,492	20,784	102,445	38,945	90,614
Mongolia	0	0	0	0	88,224
Bolivia	0	0	0	10,644	87,489
Congo	1,679	0	0	0	68,714
Ecuador	122,577	28,139	97,390	334,136	67,108
Vietnam	26,547	13,672	40,995	75,482	66,588
Croatia	17,069	15,598	46,087	98,527	60,328
Georgia	7,216	0	25,900	993	59,635
Jordan	10,485	4,245	3,359	0	58,485
St. Lucia	1,560,852	282,193	96,308	88,975	53,688
St. Christopher-Nevis	27,708	86,000	340,982	44,193	50,546
Monaco	32,872	12,399	42,709	116,545	50,200
Estonia	29,725	29,016	199,412	395,543	49,186
Kenya	27,636	65,943	23,295	338,966	45,181
Barbados	13,207	20,770	57,285	18,669	43,656
Cambodia (Kampuchea)	2,369	0	0	20,940	37,024

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Macedonia	0	0	0	0	35,408
Morocco	1,919	3,054	2,486	5,585	33,364
Mauritius	160,027	103,004	15,242	752	23,918
Ukraine	6,569	45,319	45,828	205,696	22,854
Qatar	0	1,530	2,000	10,927	22,509
Nigeria	3,549	2,999	3,883	2,679,756	21,528
Haiti	377,809	14,053	13,107	20,268	21,199
Nepal	0	5,234	12,997	17,592	17,889
Cyprus	0	85,444	66,414	19,635	17,754
Nicaragua	490	0	0	11,557	17,387
Madagascar	46,523	86,336	76,188	91,798	16,731
Bahamas	2,805	8,563	10,324	1,671	16,114
Fiji	446	0	10,409	20,334	15,866
Lebanon	2,125	4,055	252	7,202	15,516
Ivory Coast	32,705	17,502	4,496	53,209	15,128
Netherlands Antilles	0	43,256	71,610	1,500	14,740
Suriname	1,059	2,187	3,484	1,507,062	14,713
Syria	0	1,500	1,650	0	10,763
Belize	960	0	270	0	10,500
Bermuda	0	0	700	4,600	10,000
Moldova	18,500	0	0	0	8,544
Dominica	7,021	18,552	2,597	699	8,121
Antigua Barbuda	0	0	0	0	7,529
Sierra Leone	0	0	0	5,796	6,635
São Tome and Principe	0	0	0	0	6,001
Bosnia-Herzegovina	2,446	0	0	0	6,000
Guyana	3,919	10,821	14,850	83,769	5,404
Réunion	0	0	0	840	5,000
Albania	0	0	9,310	0	4,300
Montserrat	4,181	0	0	0	4,292
Gibraltar	0	0	0	0	4,162
Uruguay	11,574	157,500	103,653	10,238	4,147
Greenland	0	0	1,995	4,325	3,878
Gabon	3,857	0	1,684	1,851	3,822
Namibia	18,488	1,537	0	3,886	2,621
Malawi	0	0	0	0	2,520
Paraguay	0	1,541	0	0	2,293
Christmas Island	0	0	0	0	2,264
Brunei	2,276	8,725	0	0	2,054
Burma (Myanmar)	0	0	0	43,754	1,706
Belarus	0	912	14,511	6,797	1,592
Ethiopia	0	0	0	0	762
Zimbabwe	14,270	626	3,716	0	715
Comoros	0	0	0	0	598
Ghana	2,335	1,271	3,748	0	580
Azerbaijan	0	750	0	0	507
St. Vincent and Grenadines	0	0	0	0	446
Maldives Islands	0	0	0	0	412

<i>Country</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
San Marino	0	676	261	0	378
Tunisia	65,763	5,965	0	9,560	337
Afghanistan	18,190	0	0	0	0
Algeria	0	3,119	0	0	0
Anguilla	4,320	0	0	0	0
Armenia	23,258	6,740	15,950	4,184	0
Aruba	0	3,000	0	0	0
British Virgin Islands	727	0	1,566	0	0
Burkina Faso (Upper Volta)	0	0	0	966	0
Cayman Islands	0	2,795	0	0	0
Chad	1,280	0	0	0	0
Cocos (Keeling) Islands	0	0	4,610	0	0
Faroe Islands	1,464	0	0	0	0
Gambia	0	3,060	0	0	0
Grenada	12,783	0	0	0	0
Guadeloupe	0	1,756	11,675	0	0
Kuwait	13,500	0	5,000	0	0
Latvia	50,250	26,248	29,270	29,104	0
Lesotho	0	918	5,109	0	0
Mali	14,634	25,081	0	19,000	0
Martinique	0	0	3,159	554	0
Nauru	0	0	0	376	0
New Caledonia	19,642	0	0	0	0
Pitcairn Island	0	0	0	0	0
Senegal	0	6,860	7,443	8,576	0
Seychelles	0	5,000	0	0	0
Somalia	0	9,072	0	0	0
Swaziland	16,441	0	8,327	0	0
Tanzania	0	0	579	16,500	0
Tokelau Islands	0	16,156	0	0	0
Tonga	1,522	1,900	0	15,670	0
Uzbekistan	0	0	0	585	0
Western Samoa	0	0	12,170	0	0
Yemen (Sana)	0	0	0	23,814	0
Yugoslavia (Serbia/Montenegro)	0	11,067	12,500	0	0
Zaire	0	2,000	0	0	0
Total	3,757,825,910	3,952,022,824	4,183,831,988	4,638,984,016	5,057,395,868

Source: U.S. International Trade Commission, *Harmonized Tariff Schedule of the United States Annotated for Statistical Reporting Purposes*, 14th ed. (Washington, D.C.: U.S. Government Printing Office, 2001).

Appendix K

U.S. Imports of Water Equipment by HS Number, 1996–2000 (U.S. dollars)

<i>HS Number</i>	<i>Description</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
392690	articles of plastics, nesoi	1,908,833,690	1,910,533,895	2,025,435,385	2,284,724,537	2,527,923,676
460120	mats, matting, and screens of vegetable materials	10,958,216	7,855,350	9,612,232	12,395,215	17,179,705
560314	nonwovens, of mmf weighing > 150 g/m2	17,180,874	31,512,038	48,016,621	43,321,229	47,247,716
841360	rotary positive displacement pumps, nesoi	233,539,895	235,875,813	268,354,258	251,046,026	253,490,101
841370	centrifugal pumps, nesoi	205,625,192	226,541,461	247,372,965	280,594,744	303,390,268
841381	pumps for liquids, nesoi	144,622,078	170,963,873	157,300,796	174,472,575	178,614,131
842121	water filtering or purifying machinery and apparatus	149,569,842	138,672,248	188,164,488	240,938,783	252,919,155
842129	filter/purify machine and apparatus for liquid nesoi	163,580,306	202,143,652	197,279,724	247,935,187	255,526,675
847982	mixing, kneading, crushing, grinding machinery, etc. nesoi	110,563,006	111,874,023	117,215,608	136,468,280	148,696,105
847990	pts of mach/mechncl appl w indvdul function nesoi	813,352,811	916,050,471	925,079,911	967,087,440	1,072,408,336
	Total	3,757,825,910	3,952,022,824	4,183,831,988	4,638,984,016	5,057,395,868

Source: U.S. International Trade Commission, *Harmonized Tariff Schedule of the United States Annotated for Statistical Reporting Purposes*, 14th ed. (Washington, D.C.: U.S. Government Printing Office, 2001).